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COMPLETE URINARY OBSTRUCTION DUE TO HYDATID CYST[1]

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While echinococcus disease is not an uncommon occurrence in the United States as evidenced by the report from the Massachussetts General Hospital, from Providence, and many other parts of the country, the author has been able to find but 1 case which produced complete urinary obstruction. This was reported by Bangs of Philadelphia in 1901. Truly then, complete urinary obstruction from a hydatid is rare in America. In fact, the English literature contains but 8 such cases; two reported by Sawkins, 1 each by Wood, Wornarksy, Targett, James and Fairbanks. The text books barely mention such a possibility. Cabot's "Urology" merely states that echinococcus cysts grow in the pelvis and burst into the bladder. Kelly and Burnam state that they are occasionally met with in the kidney and in the tissues surrounding the urinary bladder and that they may rupture into the bladder and cause marked vesical irritation. Chetwood speaks of the pelvic hydatid as "one which most observers do not have the opportunity to meet."

The French literature contains the largest number of case reports. L'huillier in 1902 published 24 cases; but he failed to note those previously reported in the English literature. Jendy in 1912 and 1913 gives the details of 56 cases of pelvic hydatid cysts, 24 of which had complete urinary obstruction. Many of the cases are the same as those reported by L'huillier.

Since that time there have been a few scattering cases in literature; but most of these are also accredited to the French.

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[1] From the Brady Urological Institute, and the Department of Urology, Yale University.

The first case of pelvic hydatid cyst causing complete obstruction to urination was reported by Morand two hundred years ago. Details regarding the case together with the autopsy findings were given. The case reports of some of the later observations are meager, although the list of contributors include such men as John Hunter, Brun, Sibille, Dolbeau, Charcot, Dévé, Duplay, Valpeau, Albarran, Tuffier, etc. Yet none of these men lived in that part of the country most commonly infected with this organism.

The geographical study of the distribution of the echinococcus shows that Iceland is the most prevalent territory where it is estimated that one-sixth of the population is infected. Silesia, Australia, and Argentine follow in the order of frequency. It is not uncommon in the southern European countries, yet most writers agree that it is relatively rare in North America. Most cf the cases have been reported from Southern Europe where medicine undoubtedly was the farthest advanced during the eighteenth and early part of the nineteenth century.

While the study of the geographical distribution of the echinococcus disease shows the relative rarity of the condition in America, the study of the anatomical distribution of the echinococcus lesions emphasizes still more the infrequence of the pelvic lesion. Thomas reports 1900 cases of hydatid disease distributed as follows: liver 57.0 per cent, lungs 11.6 per cent, kidney 4.7 per cent, brain 4.4 per cent, spleen 2.1 per cent, heart 1.8 per cent, peritoneum 1.4 per cent, all other 17 per cent. Dévé reports 2727 cases; liver 74.9 per cent, lungs 8.5 per cent, muscles 5.7 per cent, spleen 2.3 per cent, kidney 2.1 per cent, cervix 1.4 per cent, bone 0.9 per cent and others 4.2 per cent. Aside from the cervix, the pelvic organs and tissues are not mentioned in these large series. But Jendy making a more detailed report of 2729 cases found 105 cases in the pelvis or 3.8 per cent.

Not all patients with pelvic hydatid cysts develop urinary obstruction. Kerwin of St. Louis reported a hydatid cyst of the pelvis which was retroperitoneal in position, but not attached to any organ. There were no symptoms referable to the urinary tract although the cyst contained 6 quarts of fluid. Most of the instances which did not have obstruction to urination did, however, have urinary disturbances manifested by frequency, dysuria, urgency and sometimes hesitancy. Since 1914, 9 cases of pelvic hydatid have been reported making a total of 114. Of these, 48 had developed complete urinary obstruction. It is estimated therefore that 1.7 per cent of all cases of hydatid disease develop total urinary obstruction.

AUTHOR'S CASE

Patient a Sicilian, aged thirty-one, single, barber by occupation, was admitted April 11, 1921, to the Brady Urological Institute and I wish to thank Dr. Hugh Young of Baltimore, for the privilege of reporting this case. He complained of difficult urination and defecation and pains in the abdomen. The family history was unimportant. The past history contained no serious illness and no operation. He had come to this country from Sicily fifteen years previous.

The present illness dates back ten months when patient began to be constipated. He had required cathartics frequently, about two or three times a week. There was no pain on defecation, and he had never noticed blood in the stools. Stools had always been dry and hard. Four months ago he developed acute retention of urine and had to be catheterized. He went to St. Joseph's Hospital in Baltimore where he was catheterized once. Following this he had frequency about every hour during the day; but never had to get up more than once in the night. Urinations had been accompanied by pain, hematuria, dribbling incontinence or burning. Size and force of stream remained good. There had been no evidence of hesitation and no intermittent action.

About three weeks ago patient began to have dull aching pain in the region of the liver near the midline in front. This took the character of a dull aching sensation localized just below the costal margin in the inferior angle of the sternum. This pain had gradually increased but had never been severe and he had never required morphia. There was no jaundice. About a week ago he developed some tenderness in the left lower quadrant of the abdomen. The pain never radiated to the left testicle, to back or across abdomen or down the thigh. It was present most of the time during the day but rarely at night. Patient had not lost any weight. He felt fairly well but was worried about his condition. While in the hospital four months ago attempt at cystoscopy was made but was unsuccessful. He thought that he had a tumor in the pelvis which was punctured through the rectum. Clear fluid was withdrawn. Patient says that he saw the fluid and it looked like water.

Examination. Patient is a fairly well developed and nourished middle aged man. There is some pallor of the mucous membranes and skin. There is no jaundice. Vital signs are normal Examination of the chest does not reveal any abnormal signs. Abdomen is not distended; it is rather prominent in upper and lower portion. Liver is somewhat enlarged. It extends from the fifth rib to two fingers breadth below the costal margin in the right mammillary line. Lower border runs horizontally across abdomen and reaches well over near the left nipple line. Surface is quite hard and tender. In the right side near the gall bladder area is a rounded mass, elevated about 1 cm. and is about 5 cm. in diameter. This area represents the tenderest point. There is a similar mass in the left side of the midline which is about one-half this size with definite tenderness. Percussion note is dull. Spleen is not definitely made out but is not enlarged to percussion. Kidneys are not palpable. There is no tenderness in the costovertebral angles. No ventral hernia. Examination of the lower quadrants of abdomen shows two small masses in left just above Poupart's ligament. Both are quite firm and move with the anterior abdominal wall. One mass is about 3 cm. in diameter, the other is about 2 cm. There is no muscle spasm or rigidity but there is a definite tenderness. A definite rounded mass which reaches three fingers breadth above the sympysis is felt. This is quite smooth, not tender, consistence not definitely made out. Percussion note is tympanitic. There is no evidence of fluid in the abdominal cavity.

Genitalia were normal.

Rectal examination. There are no hemorrhoids. Sphincter shows good tone. A large mass is felt which reaches down very close to the rectal sphincter. This mass causes the rectal wall to bulge and encroaches markedly upon the lumen. It is apparently adherent to the right side of the pelvis overhanging the prostate and extends across the pelvis. The surface is quite smooth. On the left side the tumor mass gradually spreads out covering the upper portion of the prostate and obscuring the seminal vesicle. The upper border of the mass cannot be reached. Consistence is quite firm giving the sensation of either a firmly distended thick wall-sac or a solid tumor. Definite fluctuation is not made out. Pressure on this mass is transmitted upward above the symphysis.

Prostate. Left lobe is flat and of normal size. Median furrow is obliterated. Notch cannot be felt because of the overhanging tumor. Only the lower half of the right lobe is felt and it is apparently normal except for slight induration along the periphery. Membraneous urethra is normal. No enlarged glands, no ulcerations and no palpoid masses felt in rectum.

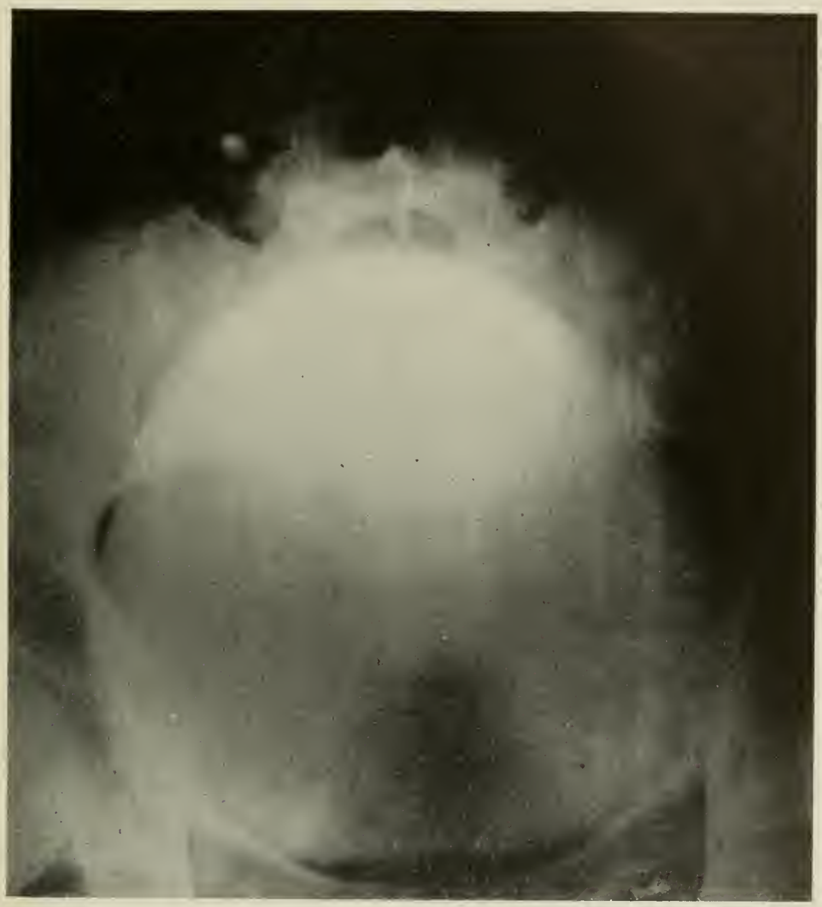

FIG. 1. CYSTOGRAM—50 CC. THORIUM NITRATE USED

Urethra. Patient apparently voids with medium sized stream and without any difficulty. Urine is clear in three glasses and is not infected. Bougie-a-boule passes to the prostatic urethra. Large and small bougies meet an obstruction in that area. Filiform, however, passes readily but the follower can not be introduced into the bladder. It meets a resistance near the vesical orifice. Direction of the urethra is deflected towards the left. Various size sounds failed to pass.

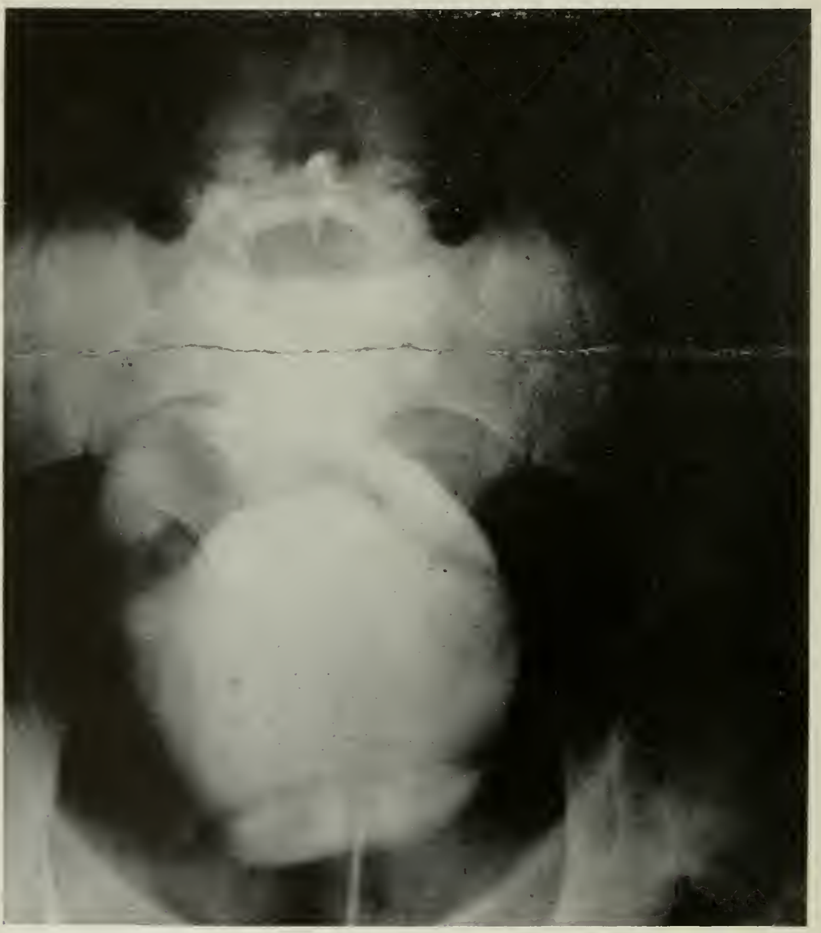

Fig 2. Hydatid Cyst Injected with 110 cc. Thorium Nitrate

Coudé catheter could not be introduced into the bladder. Bi-coudé catheter passes without much difficulty but as it reaches the prostatic urethra the canal is found to be tortuous first towards the right and then towards the left and then upward. Cystogram shows bladder is flat.

April 23, 1921: *Aspiration* of *pelvic cyst* and injection of thorium. Patient was given 0.5 grain of morphia and half hour later cyst of pelvis was aspirated through the perineum by the insertion of lumbar puncture needle under local anesthesia (procaine).

On insertion of the needle one gains the sensation of going through a very dense, fibrous wall. This is about 1.5 cm. in thickness. Firmness of this wall is not quite that of sensation obtained when inserting needle through carcinoma of the prostate, nevertheless, it required considerable force. On removal of stilette a thick, yellowish, gray pus escaped; 250 cc. of this material was removed by means of syringe attached to lumbar puncture needle.

Rectal examination after cyst had been apparently emptied, showed a mass as high up as the finger could reach. Cyst wall could be easily felt to be collapsed, but in the base of the cyst there was considerable tumor tissue. Thorium, 110 cc., was injected into the cyst cavity through the needle and stereoscopic X-ray pictures were made. Two hundred and sixty cubic centimeters of thin, watery, blood stained fluid with thorium were removed. Patient did not complain of pain during the process. Attempt was made to introduce the cystoscope into the bladder but an obstruction was met near the vesical orifice. By greatly depressing the handle of the cystoscope, it apparently passed the apex of the prostate but still did not enter the bladder.

Examination of cyst contents. A rather thin, greenish yellow, pea-soup-like pus, no odor, uniform throughout. Microscopically, pus cells, some in various stages of degeneration, and some granular precipitate. Also a few cells of various sizes containing numbers of refractile bodies or droplets. A very few red blood cells. Stained smear, no organisms; cells with refractile bodies represented degenerated cells containing many vacuoles of varying sizes. Culture showed B. coli.

April 26, 1921: White blood cells, 21,000. Stool; no ova or parasites. Wassermann negative.

April 28, 1921: Since aspiration of the cyst, patient has complained of constant abdominal pain, and has had fever 103°F. and occasional chills.

April 29, 1921: Early this morning patient complained of increased abdominal distress. Abdominal examination showed globular tumor reaching to umbilicus. Catheterized with bi-coudé, 750 cc. urine withdrawn with disappearance of tumor. At 10:45 a.m., 900 cc. withdrawn. W.B.C. 13,800; P.M.N. 87; P.M.E. 0.7; L. 6.3; LM. Tr. 6.

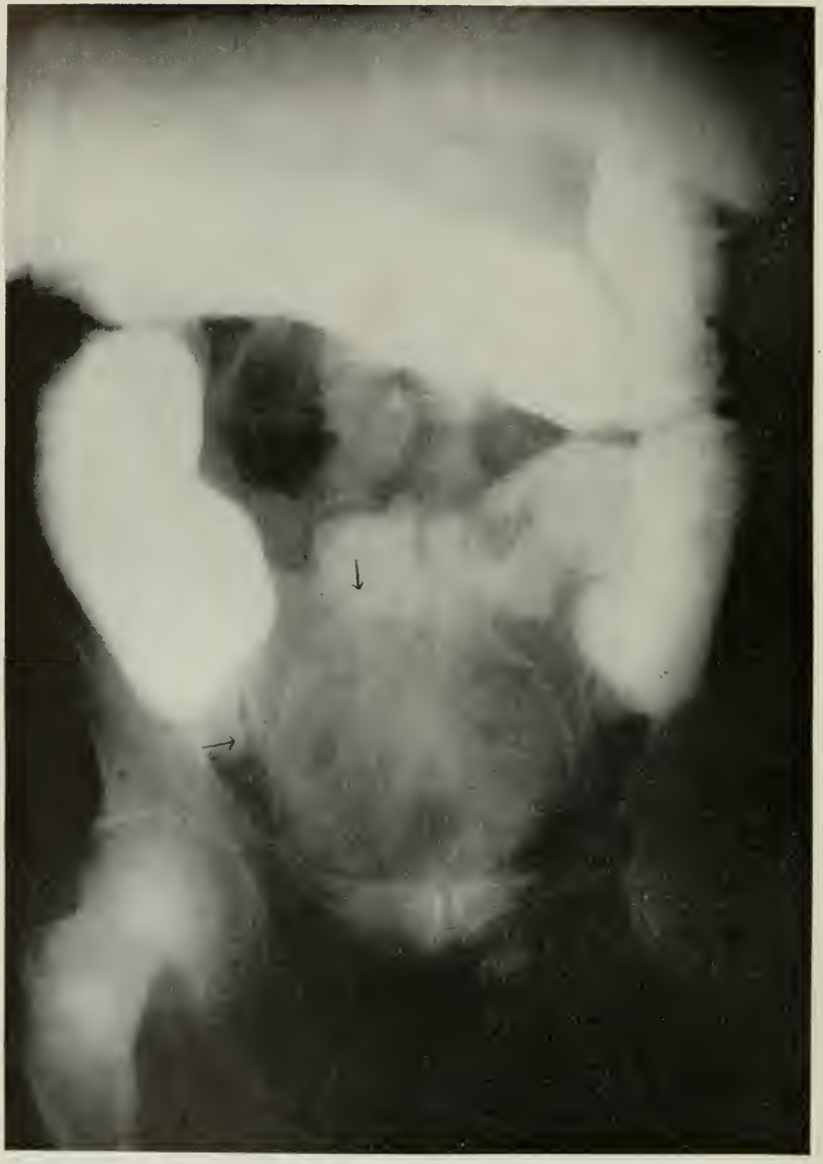

FIG. 3. BISMUTH ENEMA GIVEN THREE DAYS AFTER FIGURE 2, SHOWING ABSENCE OF ENEMA IN THE RECTUM AND AN OUTLINE OF THE CYST

Red blood cells: Moderate central pallor. Slight anisocytisis. No abnormal cells. White blood cells. No abnormal cells seen. Platelets, slightly increased in number, no parasites seen. Bismuth enema given.

May 1, 1921: The condition of the patient has gradually become much more serious during the last two days. He has had complete retention of urine for twenty-four hours and has had to be catheterized every four hours. A bicoudé catheter was passed readily. Patient complains of inability to move bowels and there is moderate distension. There is no nausea or vomiting. Pulse which is elevated to 124 is of small volume and slightly irregular. Temperature per rectum is 104°F. His color is that of a septic patient but there is no definite jaundice. On abdominal examination the respiratory movements are limited to to the upper fourth. Lower two-thirds of abdomen is distended and held quite rigid. Recti muscles show moderate muscle spasm and rigidity. No definite tumor masses are seen, no visible peristalsis, no dilatation of superficial veins. Palpation reveals an indefinite mass extending three fingers breadth above the symphysis. Outlines are not definite. Percussion note over whole abdomen is tympanitic. There is marked tenderness in left lower quadrant extending well up in flank. Examination of liver remains as stated in previous note.

Remark. The absolute diagnosis in this case is not definite. It is quite possible that this condition is an *echinococcus cyst* or congenital cyst which has become malignant. General condition is due to infection of this cyst. It seems advisable that the cyst should be opened and drained.

Operation. May 1, 1921: Incision and drainage of pelvic cyst. Dr. Deming.

Patient was first placed in the lithotomy position and a small incision made in midline above the symphysis pubis. Recti muscles were separated but on exposure of the peritoneum it was found that the small intestines were matted down on top of the bladder and the mass. It was impossible to move the bowel upward so as to reach the mass without injury to the bowel. Wound was then closed and patient was placed in the perineal position. Inverted "V" incision was made in the perineum and the membranous urethra exposed. With finger in the rectum as a guide a large aspirating trocar was inserted and 200 cc. of thin, brownish liquid together with considerable air were removed. The odor was foul and of colon nature. The opening was enlarged and a mass of greenish gray material escaped which was evidently the endo-cyst. The inner surface of the endo-cyst was studded with pin-point, yellowish nodules. After the escape of this material about 100 cc. of thick material which looked like old blood was obtained by curetage and pressure on the cyst from the rectum. Large rubber tube and two cigarette drains were inserted. There was no injury to the rectum, membraneous urethra and bladder. Condition of the patient was not very good, pulse ranging from 140 to 156. He was given stimulation of strychnine, $\frac{1}{30}$ grain and sent to the ward and given an infusion of saline solution.

Remark. Examination of the membrane showed numerous hooklets. Diagnosis is definitely made of echinococcus disease.

Post-operative condition. The retention of urine was totally relieved but patient showed obstinate constipation. He gradually developed signs of general peritonitis. Large amounts of fluids were injected but his condition became more and more grave. Pulse and temperature became elevated. The leucocytes reached 18,000 and he died on the eighth day.[2]

Autopsy by Dr. McCallum. There is general fibro-purulent peritonitis. At the base of the left lung there is an echinococcus cyst filled with numerous daughter cysts, which appears to lie for the most part in the substance of the diaphragm which splits to spread over its abdominal and thoracic surfaces, but a small lobulation of this cyst projects through the pleura and becomes adherent to the lung and, in fact, extends into the substance of the lung, reaching into the interior of the costodiaphragmatic angle of the lung.

On section there is a small cavity revealed which can be shown by the probe to be continuous with the large cavity above the diaphragm or actually in the substance of the lung, but the very minute involvement of the lung and the large size of the cyst in the diaphragm makes one think it began in the diaphragm.

Liver: The liver weighs more than 2 kgm. and measures 28 × 17 × 9 cm. The upper portion of the right lobe is covered with green thick exudate. There projects from the right aspect of the right lobe a fluctuant mass which feels rather hard. Just below this, toward the anterior edge of the liver, there is another such fluctuant mass about 4 cm. in diameter and both of these are marked off from the surrounding liver and from one another by grooved depressions filled with translucent greenish tissue rich in blood vessels. The lowermost of these cysts projects on the lower surface also. The left lobe is greatly enlarged by a lobulated cystic mass which projects from its anterior lower border and this measures 15 × 16 cm. On section it is found that the outer walls of the cysts are dense and rather opaque and that they are lined with a yellowish, opaque, granular substance but the cavities of the cysts are filled with other cysts which are in places bile-stained but which in turn contain smaller cysts with perfectly water clear liquid contents and thickly studded on the inside with greenish-white points which are recognized as heads of the worm or granddaughter cysts. The liver substance shows distinct lobulation. The lymph glands at the hilum of the liver are quite large.

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[2] All notes are abbreviated for lack of space.

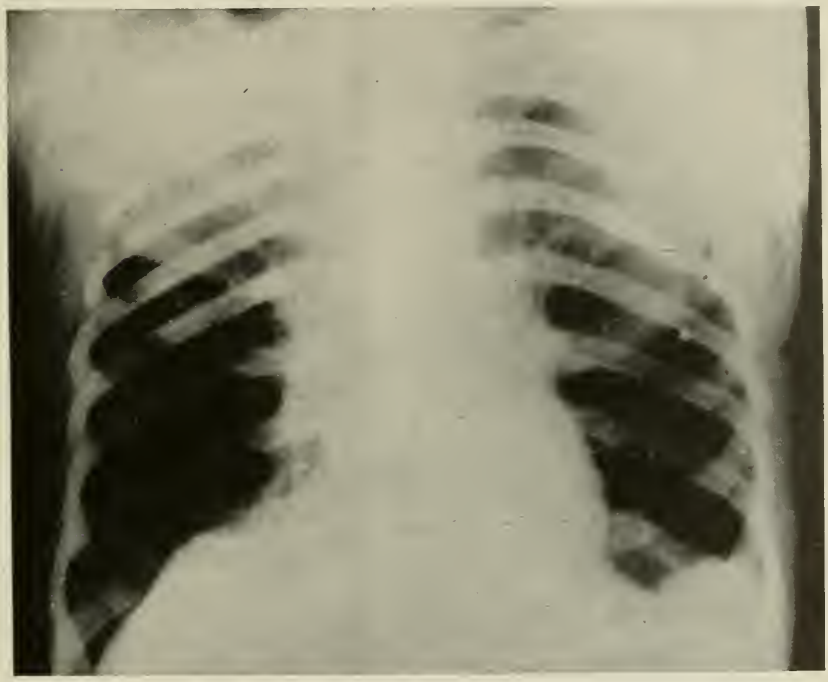

Fig 4. X-Ray of Chest and Diaphragm Showing the Hydatid Cyst in Left Costo-diaphragmatic Sulcus and Bulging of the Right Diaphragm

Prostate: The prostate seems edematous and appears to contain some minute abscesses; but outside the bladder toward the right especially—to much less extent on the left side there is a great series of intercommunicating channels, and ragged and friable material, filled with foul exudate and lined with necrotic looking tissue, and this surround a large cyst which has a rough, hard wall and is lined by opaque white, scaly-looking material in chaff-like flakes on a gray granulation tissue wall. A section through the wall of this cyst shows that it is about 2 or 3 mm. in thickness and is composed of vascular connective tissue but without distinct lamellae. Just above this mass, and projecting, therefore, from the pelvis and bounded by the colon, the left ureter and the iliac artery, is another mass about 8 cm. in diameter which is cystic and fluctuant. On section this cyst has very distinct chitnous walls and contains a water-clear fluid. The cyst contains daughter cysts and granddaughter cysts and there are numerous flattened and translucent, chitinous walls which have lost their contents. The cysts are quite fresh and show abundant echinococcus heads.

Diagnosis. Multiple echinococcus infection with cysts in the liver, diaphragm and pelvis; general fibro-purulent peritonitis.

The following are résumés of cases found in literature.

Observation 1, Morand—1722

The patient was a soldier who had for a long time complained of a tumor mass in the lower portion of the abdomen. On July fifteenth the patient entered the hospital complaining of difficulty in urination. A sound which met with a considerable obstruction in the region of the prostate was passed with great difficulty. A puncture of the bladder was done in the suprapubic region and about 2 pints of urine obtained. An incision was then made in the perineum and 5 hydatid cysts escaped. The next two or three days after the operation the patient voided naturally every hour; but the patient grew weaker and died on the 19th of the month.

Autopsy. The wound in the perineum connected with the pouch which filled the pelvis and on opening it large numbers of hydatid cysts were found. On opening the bladder a small hydatid cyst was found on the internal surface together with a small amount of clear fluid. The posterior wall of the bladder was in close communication with the large cyst which caused its upward displacement. The large cyst and the pressure of it upon the base of the bladder was the cause of the obstruction. The tumor inside of the bladder was pushed forward and compressed the internal orifice. The two cysts did not join each other but were separated at the base of the bladder by about two fingers' breadth.

Observation 2, Sibille—1755

The patient was forty-eight years of age with complete retention of urine and complained of bladder pain. He developed fever and vomited Sibille passed a sound with great difficulty accompanied by a great deal of straining and pain. This pain was located in the region of the perineum where there soon developed a large tumor which spread forward and involved the scrotum. An incision was made behind the scrotum in front of the rectum through which a large quantity of hydatid cyst material escaped. Following this the patient passed his urine partly through the perineal wound, and partly through the urethra and a sinus resulted in the perineum which required a long time for healing. Large numbers of hydatid cysts were extruded through this wound. The origin of this tumor was thought to be a hydatid cyst of liver which the patient had had at the age of twenty-eight.

Observation 3, Lolouise—1779

The patient was a carpenter aged forty years, complaining of difficult urination, and finally developed complete retention. It became impossible to catheterize him. He was taken to the Rochefort Hospital where the surgeon did a suprapubic puncture and then was able to pass a catheter. In spite of this the patient continued to have complete retention of the urine and died six days later. Autopsy revealed a tumor situated between the rectum and bladder. The volume of the tumor was equal to a "boulet 12 livres" and contained a serous limipid fluid and 10 hydatid cysts each the size of a nut.

Observation 4, John Hunter—1793

Patient was a man, forty-six years of age who had great difficulty in urination. Death followed. Bladder contained 6 pints of urine. A large hydatid cyst between the bladder and the rectum filling the whole pelvic cavity was found. Two or 3 smaller cysts were found in the neck of the bladder and many others adherent to the kidney and intestine.

Observation 5, M. LeSauvage—1812

The patient aged sixty-one years had noted that his abdomen during the past five or six years had gradually become quite large. In May, 1811, several tumors appeared which were associated with complete retention of urine. During the subsequent year he had several attacks of retention of urine which were relieved by catheterization. Rectal examination revealed a very large soft tumor pressing on the urethra. A rectal puncture of the tumor was carried out. A large amount of colorless fluid was obtained. A catheter then withdrew 4 liters of urine. Patient remained sick for a long time and died with symptoms of peritonitis.

Autopsy. Revealed 1 large and several small hydatid cysts in the abdominal cavity together with a section of gangrenous intestine caused by pressure of the cysts. There was 1 large cyst in the pelvis between the bladder and rectum which had been partly evacuated by the rectal puncture.

Observation 6, Lowel—1916

Patient was a man aged sixty-four years who had difficulty in urination for four years. The difficulty had increased and finally complete retention of urine developed. It was impossible to pass a sound which met an obstruction in the prostatic region. Rectal examination revealed a large voluminous elastic tumor which was situated in the pelvis. It filled the whole pelvis obscuring the prostatic area. Death followed.

Autopsy. A gangrenous condition of the bladder was found. In the region of the prostate there was a large tumor the size of a head of a fetus in which there was a cyst. The cyst was uniform throughout, rounded and contained many small cysts. The substance of the prostate was partly obscured within the cyst. The urethral canal was normal but was compressed by the prostatic portion of the cyst.

Observation 7, Basset—1818

Patient was a women age thirty years who had a tumor in the lower abdominal region. Patient was constipated. She had retention of urine. Catheterization was difficult and finally became impossible. Death finally ensued.

Autopsy. One of the ovaries was found to be transformed into a large hydatid cyst, the size of an adult's head.

Observation 8, Barret—1828

The patient was a woman thirty-two years of age. For several months she had had a cessation of her menstrual period and had developed a tumor in the lower abdomen. She thought she was pregnant. For about a month she had had considerable pain in the region of the symphysis. Urination was difficult and finally she developed complete obstruction. Vaginal examination was very difficult and painful. Three days after admission a large tumor was found in the pelvic cavity. Patient became very sick with a definite peritonitis and died.

Autopsy. The lower portion of the abdomen was filled by a large mass which was retro-peritoneal. In the gastro-splenic region there was a hydatid tumor which contained orange, yellow colored fluid. Between the rectum and uterus there was another cyst which was adherent to the body of the uterus. On the lateral wall of this cyst, there were two openings connecting with the gall bladder. This cyst also connected with the Fallapian tube which in turn drained into the uterine cavity.

Observation 9, Brun—1834

The patient was forty years of age, well developed, well nourished when first seen in the first part of 1828. At that time he complained of of heaviness in the abdomen and an occasional colicky pain. The abdomen was increased in size especially in the left lower quadrant where there was found a large tumor.

In April, 1834, the patient had complete urinary obstruction and required catheterization. Pulse was small and thready and temperature was elevated. The tumor now filled the left lower quadrant of the abdomen and extended upward toward the epigastrium. On the 8th, the patient had a severe attack of abdominal pain which was relieved by a movement of the bowels. The movement contained pus and much liquid material with small round vesicles. After the pain subsided the temperature returned to normal. The contents passed from the rectum contained hydatid cysts. The tumor subsided within two or three years. The urine, however, was passed with some difficulty, but there was no trouble with the bowel movement.

Patient next developed pain on urination and passed gas from the urethra. The urine was cloudy at times. Rectal examination revealed a small tumor adherent to the bladder and the rectum.

Observation 10, R. James—1842

On July 17, 1842, patient aged fifty-nine years was admitted with complete retention of urine. Bladder was greatly distended for he had not voided for thirty-six hours. He was placed in warm bath and catheter passed which met an obstruction at the bladder neck.

On July 21, cystotomy was done through the perineum with the escape of a pint of urine without relief of pain or the evidence of any change in the abdominal tumor. Patient died next day.

Autopsy. Showed large hydatid cyst behind the bladder cuasing pressure in such a manner that the bladder was divided into two parts. The upper part had not been drained and contained two pints of urine. The lower portion had been drained by the perineal puncture.

Observation 11, Blondeau—1849

Man was admitted with complete retention of urine. A suprapubic puncture was carried out. The patient died shortly afterwards.

Autopsy. Showed hydatid cyst filling the pelvic cavity situated between the bladder and rectum. A second cyst was found adherent to the cecum.

Observation 12, Leudet—1856

The patient was a woman aged seventy-two years, with complete retention of urine. Patient was too sick to be examined. Vaginal examination, disclosed a tumor which was located at the cervix and was thought to cause a retro-flexion of the uterus. The woman died shortly afterwards.

Autopsy. No peritonitis was noted. The liver was somewhat increased in size. On the border of the left lobe there was a small hydatid cyst the size of a pigeon's egg. The uterus was reflected to the right, and between it and the rectum, there was a large rounded tumor the size of a child's head. The interior of the tumor was characteristic of a hydatid cyst.

Observation 13, Valpeau—1862

The patient aged thirty-three years had noticed that abdomen had gradually increased in size, accompanied by difficult urination and finally complete retention. Catheterization of the bladder made no change in the size of the abdominal tumor. Rectal examination revealed a large smooth tumor which was thought to be a hydatid cyst. Dr. Valpeau punctured the tumor through the rectum. The patient died in a few days.

Autopsy. Showed a phlegmonous peritonitis. The liver contained a large number of small suppurating hydatid cysts. Between the rectum and bladder was a large cyst which had been evacuated by the rectal puncture.

Observation 14, Dolbeau—1867

A lemonade-seller aged twenty-six years complained of a tumor which was presenting on the right side of the anus. It was soft and fluctuating. Rectal examination transmitted the sense of fluctuation to the perineal surface of the tumor.

The touch of his clothes was painful and the stools were ribbon-like. The urinary difficulty increased to complete retention.

A puncture through the rectum was made and 250 cc. of liquid obtained. It did not coagulate nor did it show any hooklets. Patient developed temperature and was nauseated for several days. A large incision was then made through which escaped the contents of a hydatid pocket. Recovery.

Observation 15, Freund et Chadwick—1874

The patient was a woman, fifty-seven years of age who complained for six years of pain on urination and defecation. These two functions were carried out simultaneously. Patient had noticed for the past several months that her abdomen had gradually increased in size. Pelvic examination showed a large tumor which was adherent to the posterior wall of the uterus. The cavity of the uterus measured 14 cm. in length. The urethra was also elongated. Evacuation of the tumor showed large numbers of vesicles of hydatid.

The uterus was irregular and enlarged and anti-flexed. The patient complained of a great deal of pain and tenderness about the bladder. She passed a good many hydatid vesicles in the urine; a hydatid membrane by the way of the vagina and later hydatid vesicles per rectum. The patient became ematiated and died.

Autopsy. Showed a vast destruction of the pelvic organs. There was a sinus connecting the rectum, uterus, and vagina. There were no hydatid cysts in the abdominal cavity.

Observation 16, Martini—1879

The patient was a woman twenty-two years of age who has been suffering for six months with dysmenorrhoea, dysuria, and severe pain in the left inguinal area. The cul-de-sac of Douglas was distended with a large tumor which elevated the uterus. Patient had a temperature of 40.5°C. A laparotomy was performed by Dr. Martini. Many adhesions were found between the tumor and the intestine. The cyst was then punctured and its edges sutured to the abdominal wall. It was impossible to remove the membrane of the hydatid cysts. Drainage was obtained through the vagina. A lavage of the cyst was made with strong carbolic acid solution. The wound healed in four weeks.

Observation 17, S. Zichy Worsnarsky—1881

The patient, age twenty-three had had retention of urine for two weeks. Catheterization was extremely painful and difficult. Following catheterization there was pain and constant desire to urinate. On admission to the hospital there was considerable temperature and an occasional chill associated with vomiting, nausea, and pains in the legs. Rectal examination showed a large semi-fluctuant tumor above the prostate. This tumor compressed the rectal lumen. It was, therefore, decided to do a puncture of the bladder. Two quarts of urine were obtained. Patient gradually grew worse and died that evening.

Autopsy. On the interior and posterior surfaces of the bladder there were two cysts which were adherent to the bladder. In the pelvis there was a large mass which could not be separated from the pelvic organs. Examination of the contents of the cysts showed a large number of echinococcus bodies.

Observation 18, M. Tillaux—1883

A man forty-two years of age complained of difficult urination and constipation alternating with diarrhoea which extended over a period of two years. Rectal examination revealed a large tumor in the region of the prostate. Catheterization was difficult. An incision was made in the rectum directly over this tumor mass and there escaped a large amount of clear fluid. Finger introduced into this cavity showed that it was 6 or 7 cm. deep. The urine remained clear but the patient had complete obstruction of urination for three days. Patient developed a temperature and abdominal pain which indicated peritonitis. Three days later the patient urinated voluntarily clear urine. Patient soon passed through the rectum a membrane resembling that of a hydatid. Following this there was no difficulty in urination and the rectal wound began to heal. Patient was discharged cured in three weeks.

Observation 19, Fischer—1883

The patient was twenty years of age. He had been examined three times for complete retention of urine and after catheterization each time retention came on more quickly. A tumor was felt in the lower abdomen and on rectal examination. In the perineum there was found a painful tender tumor. An incision was made. Hydatid membranes escaped. Result: cured.

Observation 20, M. Nicaise—1884

The patient, age fifty-nine complained of difficult urination. Dr. H. Miller found a large cystic tumor occupying the region of the prostate. Six months later he had complete retention of urine. Attempts at catheterization were unsuccessful. Dr. Millet, therefore, decided to do a vesical puncture and obtained about a liter of urine. Rectal examination following this puncture revealed still the existence of a pelvic tumor. Being absolutely sure that urine was obtained at the puncture the patient was advised to again seek Dr. Millet who advised passing a metal catheter. On passing this catheter and removal of the same a portion of a membrane escaped. The metal sound was not passed into the bladder but was inserted into another cavity which caused the evacuation of 700 cc. of fluid containing hooklets of echinococcus. Following this the urine caused a great deal of burning and smarting and it became very purulent and contained small pieces of membrane. Patient left the hospital in three weeks. Urination was normal.

Observation 21, Lum

The patient was sixty-six years of age. He had had several punctures of the bladder through the suprapubic region for retention of urine. Rectal examination revealed a tumor behind the bladder.

Autopsy. Between the bladder and rectum was a hydatid cyst the size of an infant's head. The bladder contained purulent urine. The ureters and kidney pelves were dilated.

Observation 22, M. Duplay—1887

The patient, age thirty-five, had had frequency of urination which occurred every two hours for five months. The frequency of urination had become more and more difficult and was accompanied with a great deal of pain at the beginning. Pain was localized in the small of the back and in the kidney region. Examination showed a tumor of the abdomen lying in the mid-line between the symphysis pubis and the naval. Rectal examination revealed a tumor on the anterior portion of the rectum. It was thought that the condition was a hydatid cyst of the prostate or peritoneum. A puncture was done by means of the trocar and 1650 grams of clear liquid containing hooklets were removed. The tumor entirely disappeared. In two weeks the tumor had again appeared in its former size. A second puncture was done and 1500 grams of liquid were removed. This also contained large numbers of hydatid hooklets. Fourteen days later the patient left the hospital, free from all pain and difficulty in urination. This patient has been cured by two punctures of the hydatid cyst.

Observation 23, Fairbanks—1890

A man aged sixty-three years complained of retention of urine. Finally catheterization was impossible. A puncture of the bladder through the rectum was supposedly done. One hundred and thirty cubic centimeters of opalescent liquid was obtained. Patient then could void. Six months later the urine contained hydatid cysts escaping from the perivesical pocket which was connected with the bladder.

Observation 24, Dr. Fürstenberg—1890

Patient was a man aged thirty years who complained of frequency and retention of urine for six months. Examination of the abdomen showed a tumor in the hypogastrium simulating a distended bladder. Rectal examination revealed a rounded, smooth tumor. Catheterization gave 400 cc. of urine tinged with blood. The abdominal tumor was not influenced by catheterization. Complete retention persisted the following day. First attempt at catheterization was unsuccessful; but the second time a large amount of bloody urine with clots was obtained. Hematuria continued.

Operation. A transverse hypogastric incision was made. On opening the bladder large numbers of clots and hydatids were obtained. The mucosa was sutured to the skin and the bladder packed. A cavity behind the bladder was opened and found to contain a large quantity of pus and hydatids. This cavity communicated with the bladder. Little by little this communication healed. Later another tumor appeared in the lower abdomen but the patient refused operation and left the hospital.

Observation 25, Fenwick—1891

The patient, twenty-five years of age, had had a tendency for the previous six months to have morning vomiting and was undergoing progressive emaciation. For six years he had had an irritable bladder with retention of urine. On rectal examination there was found a large tumor semi-fluctuating, filling the whole of the cul-de-sac. Dr. Fenwick punctured the tumor through the rectum and obtained about an ounce of hydatid liquid. The catheter was immediately passed into the bladder through the urethra and about 2 ounces of urine were obtained. The next day the patient voided about 30 ounces of urine spontaneously. The patient then developed retention of urine and it was decided to give suprapubic drainage. The patient developed subsequently an anuria and died.

Post-mortem examination revealed a large mononuclear hydatid cyst which was causing hydro-ureters with atrophy of the kidneys. No other cyst seen.

Observation 26, M. Tuffier—1891

The patient aged thirty-seven years had suffered from frequency of urination for three years. Micturition had become progressively difficult so that catheterization was resorted to and even this became extremely painful and finally impossible. Abdominal and rectal examinations revealed a large smooth mass. Two suprapubic punctures were attempted for relief of the distended bladder without success. A suprapubic exploration was then carried out which disclosed a large hydatid cyst containing 2 liters of fluid situated between the bladder and prostate. The cyst cavity was washed out with bichloride of mercury; the cyst wall sutured to the sides of the wound; and the cavity packed with iodoform guaze. The patient had a stormy convalescence but completely recovered in two months. The wound became firmly healed and normal urinations were resumed.

Observation 27, N. le Dr. Vincent—1892

A man aged twenty-four years entered the hospital with retention of urine and signs of intestinal obstruction. Rectal examination detected the presence of a tumor filling the cul-de-sac and encroaching upon the rectum. A puncture through the rectum resulted in the escape of 60 cc. of hydatid liquid, some gas and matter. The author then decided to do an immediate laparotomy. Behind the bladder was found a cyst which was opened and its walls were sutured to the wound. The cyst contained about a liter of foul infected fluid. The wound began to heal normally. Retention of urine disappeared, cicatrization progressed satisfactorily, but a fistula persisted until after a piece of hydatid membrane came away. Patient was discharged cured after ten weeks.

Observation 28, Sawkins—1893

On April 10, A.B.W., male, laborer, brought to the hospital by police, apparently had no rectal or vesical control. On examination he was found to have retention of urine with passive overflow. A soft catheter was passed, and 35 drams of urine drawn off. Rectal examination revealed a large tumor which was believed to be a greatly enlarged prostate. On the 13th a catheter could not be passed. Suprapubic aspiration withdrew about 35 drams of urine. On all future occasions a gum elastic catheter overcurved on a stylet was passed with ease. In addition to bladder and rectal symptoms, patient complained of inability to walk and pain along the course of the left sciatic nerve. He gradually became weaker and died on the 15th from exhaustion.

On post-mortem examination a large cyst, which contained over a pint of fluid and daughter cysts was found to fill the pelvis, pressing on the rectum and bladder. There were numerous small cysts attached to pelvic viscera, liver and omentum.

Observation 29, Sawkins—1893

J.F., miner, thirty-nine years, complained of difficulty in urination which began three months previously. He has had several attacks of retention of urine. Hydatid disease being suspected, an exploring needle was inserted from the front and clear fluid obtained. Dr. Sawkins operated immediately by suprapubic incision, but finding it impossible to reach the cyst, prolonged the incision upwards, opened the peritoneum; stitched the sac to the abdominal wall, evacuated the contents, and removed the endocyst. A drainage tube was inserted. Patient had an uninterrupted convalescence and was discharged cured after five weeks.

Observation 30, Villar—1893

The patient aged thirty-five had noticed for the past eight years two small round hard tumors in the abdomen. Urinary difficulty dated back to only four months with gradual impending retention. Several punctures of the cyst above the pubis were made each time obtaining a liter of clear fluid. Finally a suprapubic drainage of the cyst behind the bladder and also one in the liver was done. The wounds healed in eight weeks.

Observation 31, M. le Dr. Schwartz—1894

The patient was a girl of eighteen years whose present illness began with a dull aching pain in the abdomen especially in the left lower quadrant. At times the pain became lancing and penetrated to the left side of the abdomen. Walking or standing increased the pain. There was also some difficulty in defecation. Patient then developed vomiting. Vaginal examination at this time revealed a normal uterus but behind it there was a large tumor the size of a child's head.

Operation consisted of a puncture through the vagina; 750 cc. of clear fluid were removed. Microscopic examination showed that this fluid contained echinococcus hooklets. Recovery was complete in twenty-eight days.

Observation 32, Routier—1894

Patient aged thirty-two years complained of difficulty in urination. Retention was absolute except for a few drops that escaped on great effort. A large rounded tumor was noted in the abdomen. Rectal examination; cul-de-sac filled with tumor, which was hard, immobile, attached below to fascia and above to the wound.

Treatment. Incision and drainage with excision of most of the tumor. Result: cured.

Observation 33, Ocampo—1896

A man aged thirty-eight years complained of a mass in the ilium. A diagnosis of impacted fecal material was made. This was removed at operation. A few days later there developed a rise of temperature, retention of urine, collapse and death.

Autopsy showed a hydatid cyst the size of an ostrich egg in the pelvis adherent to the posterior wall of the bladder and anterior wall of the rectum. It contained many small hydatid vesicles. Dilatation of the ureters and kidney pelves were found.

Observation 34, Rotgans—1896

The patient was a man forty years of age with complete retention of urine. He had had several suprapubic punctures for the condition. A transvesical operation was performed with perineal drainage. Result: cured.

Observation 35, M. M. Hereseo et Herenschmidt—1898

The patient aged twenty-four had suffered three attacks of acute retention in six weeks. Rectal examination revealed a large tumor behind the bladder. A perirectal incision was made but the condition was not relieved. Three days later a suprapubic incision was made at which time a large amount of sero-sanguinous fluid escaped. The patient's condition was critical for one week at which time a large amount of hydatid material escaped through the suprapubic incision. The wounds healed perfectly in eight weeks and normal urination was restored.

Observation 36, Gaston Getten—1898

A male patient aged twenty-five had had frequent urinations for ten years. Finally urination was very painful and extremely difficult. Examination revealed a large tumor in the left lower quadrant. Rectal palpation also disclosed a large tumor behind the bladder. Bimanual examination gave the characteristic "fremissement" of a hydatid. The cyst was drained by the suprapubic route and the cavity sponged out with bichloride of mercury. The patient was discharged after sixteen days with wound well healed and all symptoms absent.

Observation 37, L. Bolton Bangs—1901

Patient aged thirty-nine years had had complete retention of urine for two days. His abdomen was greatly swollen. He was catheterized every two hours. A large tumor was found in the abdomen in the left lower quadrant. The urethra was elongated and tortuous. Rectal examination revealed a large mass continuous with the one in the abdomen. A suprapubic incision disclosed a large hydatid cyst between the bladder and left side of the pubis. The edges of the cyst were sutured to the wall of the abdomen and the cyst cavity washed out daily with 1:5000 bichloride. Wound closed in eight weeks.

Observation 38, Saxchansky—1901

A male patient aged fifty years entered the hospital for complete retention of urine. The first trouble with micturition began about six months previous. Urinations were frequent and painful followed by complete retention. The retention was associated with obstinate constipation. A catheter was passed and 800 cc. of urine obtained. The abdomen was very large and sensitive. Rectal examination revealed a tumor the size of an infant's head. It was firm and did not fluctuate. A diagnosis of sacoma of the prostate was made A perineal incision was made and followed by the escape of many hydatid vesicles. Result: cured.

Observation 39, M. Hartmann—1902

A male aged eighteen years complained of difficult urination. Two days later complete retention developed. Seven years previously he had noticed a tumor in the abdomen and a second one three years later. Examination showed a large tumor in the epigastrium. Rectal palpation revealed a large cystic tumor behind the bladder. A suprapubic drainage of the pelvic cyst was made but the large tumor of the liver remained. The wound healed completely in eight weeks and normal urination was resumed.

Observation 40, Hartmann—1904

Patient aged thirty-one years was admitted on May 11, 1904. He complained of progressive difficult urination for one month. Shortly after entry to hospital he developed complete retention of urine. Examination showed the bladder to be distended up to the naval. The urethra was explored with no. 20 sound and found to be free. Rectal examination showed the lower portion of the prostate to be normal but continuous with the upper portion was a rounded tumor which extended 4 fingers breadth to the right of the navel after the bladder had been emptied. The patient was operated on eight years previously for hydatid cyst of the liver. The patient refused operation.

Observation 41, Wood—1904

Patient aged sixty-eight years was suffering from complete retention of urine. The bladder was distended up to the navel and was relieved by passing small catheter. Rectal examination showed a large firm swelling in front of the rectum. The urine was normal.

Operation. Suprapubic cystotomy. A hydatid cyst was found beneath the mucous membrane of the base of the bladder. Most of it was excised. Perineal as well as suprapubic drainage was given. Patient did well for twelve days. He then became lethargic, refused food and died on the fifteenth day.

Autopsy. Showed the cyst to be retrovesical in position. Both ureters and kidney pelves were dilated. There were numerous small cysts in the liver.

Observation 42, Haveczky—1905

The patient aged forty-five years was admitted on September 4, 1904. About February 1 he began to notice frequent and difficult urinations. By March 1 he had developed complete retention and since that time constipation.

Examination showed the bladder moderately dilated. Rectal examination showed a tumor the size of a child's head, occupying the prostatic region. Its surface was smooth, regular, and round. Catheterization was carried out after which palpation revealed a large tumor extending up into the abdomen from the pelvis.

A puncture through the rectum gave a clear fluid with echinococcus hooklets. The cyst was drained by means of a perineal incision.

Result: incontinence of urine.

Observation 43, Cranwell—1907

Patient aged fourteen years complained of frequent and painful urinations. An obstruction to urination persisted for about one month. After about a year he began to run a temperature and the urinary difficulties increased again. He then noticed a tumor in the lower portion of the abdomen. He also complained of obstinate constipation.

Examination. Patient was emaciated—facial expression denoting pain. A tumor in the epigastrium was found extending between the symphysis and navel. Rectal examination showed a tumor between the bladder and rectum.

Operation. A suprapubic cystotomy was performed. On opening the bladder a cyst was found behind it which contained clear liquid. Patient became worse and died with subnormal temperature.

Autopsy. Plastic peritonitis found and in the pelvis a cystic wall the size of a child's head. Both kidneys showed small hydatid cysts. The liver was free.

Observation 44, Cranwell—1907

The patient aged twenty-three years complained of dysuria of three months duration. Complete retention followed. Abdominal examination revealed 5 tumors between symphysis and navel. A volumnious cystic tumor was felt on rectal examination. A laparotomy disclosed a group of hydatid cysts varying from the size of a hen's egg to that of an orange. Two large cysts were found in the pelvis. The small cysts were removed while the walls of the larger ones were sutured to the wound and the cavities sponged out with formaldehyde. The wound healed completely in sixteen days and the patient was able to urinate normally.

Observation 45, M. Marion—1914

Patient aged fifty-four years complained of urinary difficulty for six years. Polakuria had persisted for two years at night. Dysuria, hesitancy and dribbling were prominent symptoms. Rectal examination showed a large tumor above the prostate. A laparotomy was performed removing the whole cyst which proved to be a hydatid. Convalescence was uneventful.

Observation 46, Ed. Potherat—1917

A soldier aged twenty-six years had sudden onset of acute retention of urine. Rectal examination revealed a large mass between the bladder and rectum. The bladder was greatly distended. Catheterization was carried out daily for two weeks. A severe cystitis followed. A suprapubic incision was made, the hydatid cyst emptied, and the endocyst dissected out. The cyst wall was sutured to the peritoneum and the cavity drained. The wound healed and the patient was returned to the army in ten months.

Observation 47, Thevenot—1920

Patient, aged twenty-four entered clinic of Professor Rechet on September 14, 1916, for dysuria which began in August, 1916. He had acute retention. There was some difficulty in catheterization. A no. 18 sound met an obstruction 14.5 cm. from meatus. A no. 18 metal sound was passed with ease and 600 cc. of clear urine were obtained. No albumin and no blood found.

Rectal examination showed the prostate to be soft, but independent of the prostate there was on the left side an elongated mass the upper limits of which could not be reached. It was soft and immovable. Diagnosis of sarcoma was made.

On October 25, 1916, an incision was made in the perineum parallel to the left ischio pubic ramus to the upper border of the tumor. It was punctured and found to contain 175 cc. of clear yellow fluid, the last 40 cc. were bloody and contained remnant of a hydatid cyst. The cyst was very firmly attached at its base but free from the bladder. The cyst was drained and healed completely by December 18.

DISCUSSION

Incidence

Total urinary obstruction due to hydatid of the pelvic tissues occurs most often in young adult and middle life. It is less common in youth and old age although it is not uncommon in the sixth and seventh decades. Twenty-five of the 46 cases (ages of 2 not given) were seen between the twentieth and fortieth years. Cranwell reported the youngest instance in a male of fourteen years. The oldest, a female seventy-two years, was reported by Leudet. The male sex is more prone to develop urinary obstruction, the ratio being 6:1. Of the 48 cases, 41 were males and 7 were females.

TABLE I

NUMBER	DATE	CASE REPORTED BY	SEX	AGE	RESIDUAL URINE	LIVER INVOLVED	POSITION	PERITONITIS	OPERATION	RESULT	TIME
					cc.						
1	1722	Morand	M.	26	1000	0	Retro-ves.	+	Suprapubic puncture of bladder + perineal incision	Died	
2	1755	Sibille	M.	48		+	Retro-ves.	0	Incision in perineum	Cured	Several weeks
3	1779	Lelouise	M.	40		0	Retro-ves.	0	Suprapubic puncture of bladder	Died	6 days
4	1793	Hunter	M.	46	3000	0	Retro-ves.	0	None	Died	
5	1812	Lesauvage	M.	61	4000	+	Retro-ves.	+	Rectal puncture	Died	
6	1816	Lowel	M.	64		0	Retro-ves.	0	None	Died	
7	1818	Basset	F.	30		0	Ovary	0	None	Died	
8	1828	Barret	F.	32		0	Rect.-ut.	+	None	Died	
9	1834	Brun	M.	40		0	Retro-ves.	0	Spontaneous rupture into rectum	Cured	
10	1842	James	M.	59		0	Retro-ves.	0	Perineal cystotomy	Died	8 hours
11	1849	Blondeau	M.	(?)		0	Retro-ves.		Suprapubic puncture of bladder	Died	Shortly
12	1856	Leudet	F.	72		+	Retro-ves.	0	None	Died	
13	1862	Valpeau	M.	33	1000	+	Retro-ves.	+	Rectal puncture	Died	
14	1867	Dolbeau	M.	26		0	Retro-ves.	0	Rectal puncture and incision	Cured	
15	1874	Freund et Chadwick	F.	57		0	Rect.-ut.	+	Colpotomy	Died	
16	1879	Martini	F.	22		0	Rect.-ut.	0	Suprapubic drainage + suture, vaginal drainage + irrigations strong carbolic acid solution	Cured	
17	1881	Worsnarsky	M.	23	2000	0	Retro-ves.	0	Suprapubic puncture of bladder	Died	Few hours
18	1883	Tillaux	M.	42		0	Retro-ves.	0	Incision in rectum	Cured	3 weeks
19	1883	Fischer	M.	20		0	Retro-ves.	0	Incision in perineum	Cured	
20	1884	Nicaise	M.	59	1000	0	Retro-ves.	0	Spontaneous rupture into bladder	Cured	4 weeks
21	(?)	Lum	M.	66		0	Retro-ves.	0	Suprapubic puncture bladder	Died	
22	1887	Duplay	F.	35		0	Retro-ves.	0	Suprapubic punctures cyst (2)	Cured	6 weeks
23	1890	Fairbanks	M.	63		0	Retro-ves.	0	Rectal puncture	Improved	
24	1890	Fünstenberg	M.	30	400	0	Retro-ves.	—	Transvesical drainage of cyst	Cured	Recurrence
25	1891	Fenwick	M.	25		0	Retro-ves.	+	Rectal puncture	Died	
26	1891	Tuffier	M.	37		0	Retro-ves.	0	Suprapubic, drainage; suture; bichloride lavage; iodoform gauze	Cured	8 weeks

27	1892	Vincent	M.	24		0	Retro-ves.	0	Rectal puncture; suprapubic drainage + suture	Cured	10 weeks
28	1893	Sawkins	M.	?	140	+	Retro-ves.	+	Suprapubic puncture of bladder	Died	
29	1893	Sawkins	M.	39		0	Retro-ves.	0	Suprapubic incision; suture marsup.	Cured	6 weeks
30	1893	Villar	M.	35		+	Intra.-ves.	0	Suprapubic incision; drainage of pelvic and liver cysts	Cured	8 weeks
31	1894	Schwartz	F.	18		0	Retro-ves.	0	Colpotomy	Cured	3 weeks
32	1894	Routier	M.	32	1200	0	Retro-ves.	0	Suprapubic incision; marsup.	Cured	
33	1896	Ocampo	M.	38		0	Retro-ves.	0	None	Died	
34	1896	Rotgans	M.	40		0	Retro-ves.	0	Suprapubic puncture; suprapubic and perineal drainage	Cured	
35	1898	Heresco et Herenschmidt	M.	24		0	Retro-ves.	0	Suprapubic and perineal drainage	Cured	10 days
36	1898	Getten	M.	28		0	Retro-ves.	0	Suprapubic incision; bichloride lavage; tight closure	Cured	16 days
37	1901	Bangs	M.	39	500	0	Retro-ves.	0	Suprapubic incision + suture bichloride lavage	Cured	8 weeks
38	1901	Saxahansky	M.	50	800	0	Retro-ves.	0	Perineal incision	Cured	
39	1902	Hartmann	M.	18	1500	+	Retro-ves.	0	Suprapubic incision + suture	Cured	10 weeks
40	1904	Hartmann	M.	31		+	Retro-ves.	0	None (refused)		
41	1904	Wood	M.	68		+	Retro-ves.	+	Suprapubic + perineal incision	Died	12 days
42	1905	Haveczky	M.	45		0	Retro-ves.	0	Rectal puncture	Incont.	
43	1907	Cranwell	M.	14		0	Retro-ves.	+	Suprapubic incision	Died	
44	1907	Cranwell	M.	23		0	Retro-ves.	0	Suprapubic incision and suture + formaldehyd lav.	Cured	16 days
45	1914	Marion	M.	54		0	Retro-ves.	0	Suprapubic incision of cyst	Cured	
46	1917	Potherat	M.	26		0	Retro-ves.	0	Suprapubic incision+suture and marsup.	Cured	10 months
47	1920	Thevenot	M.	24	600	0	Retro-ves.	0	Perineal incision	Cured	8 weeks
48	1922	Deming	M.	31	900	+	Retro-ves.	+	Perineal incision	Died	7 days

Retro-ves. = cyst between rectum and bladder.
Rect.-ut. = cyst between rectum and uterus.
Intra-ves. = cyst intravesical.
Incont. = incontinence of urine.

Anatomical pathology

Charcot in 1852 wrote the first comprehensive treatise on hydatid cysts of the cul-de-sac. He concluded that they originated in the cellular tissue behind the peritoneum between the bladder and rectum and did not develop within one of the pelvic organs. In most of his patients he was able to demonstrate cysts of the liver so that he was of the opinion that the pelvic cysts were secondary to those of the liver. Dolbeau in 1867 took issue with Charcot and demonstrated that these cysts developed in the tissue between the bladder and rectum in man and between the rectum and vaginal wall in women and that they were primary and not secondary cysts. Davaine who was also an authority on hydatid cysts believed that they occupied the extra peritoneal cellular tissue in the pelvic cavity and that they were not always primary in this region. Bouilly in 1830 described the condition as one of a chronic nature and of remarkable anatomico-pathological interest. He stated that it was extremely rare on the anterior part of the bladder but relatively frequent behind the bladder, between it and the rectum. Tillaux thought that the cysts were located in the wall of the bladder because the cyst wall often contained muscle fibers. Albarran writing later agreed with Charcot. Tuffier in 1891 brought forth the idea that they were primary in the fascia of Denonvillier or the peritoneal aponeurosis of the prostatic gland. Targett thinks that the specimens in the London museums show that the cysts originally start in the plane between the muscle coat of the bladder and the sheath of the recto-vesical fascia. Sawkins reports in detail the autopsy of such a case. The largest number of observers are of the opinion that these cysts develop in the retroperitoneal cellular tissue between the bladder and the rectum and rarely in any of the pelvic organs.

Charcot's theory of primary echinococcus cysts in the liver with secondary cysts in the pelvis does not hold in all cases; for only 6 out of the 19 patients autopsied in this series showed cysts of the liver. Many of them had only 1 cyst; others multiple abdominal cysts which were smaller than the one in the pelvis. Just what factors cause the location of the cysts is unknown.

Fagg believes that they arise from the growth of the embryo which has fallen by its own weight into the pelvic cavity after perforating the walls of the stomach. Most writers agree that the infection is a hematogenous one; that the organism passes through the wall of the bowel, gains entrance to the lymphatics and from thence into the vascular system. This theory is supported by the fact that between 50 and 70 per cent show liver lesions and that every organ in the body has been found involved. Basset reports a case where the ovary was the only organ affected. Villar and Morand each give instances of cyst within the bladder which gave rise to complete urinary obstructions. Tillaux thought the character of the covering of an organ was a factor in the location of the cyst. Lesauvage and Legrande propounded the theory of the existance of a small pouch near the neck of the bladder in which there is a small round entrance into which the organisms entered and grew because the musculature of the cyst wall and the bladder was the same. Whether they reach the pelvic tissues by way of the blood stream, lymphatics or directly through the rectal wall is uncertain. It is possible to believe, however, that since not all the cysts are to be found in the same tissues in the pelvis that some, especially the ovarian and intravesical hydatids may be hematogenous while those in the cellular tissue between the bladder and rectum may have gained entrance directly through the rectal wall. Autopsies and investigations still leave this factor unsolved.

The size of the cysts varies from that of an orange to that of the head of a full term human fetus. The cyst wall is 2 to 5 mm. in thickness and composed of firm fibrous tissue and sometimes muscle fibers when the cyst is attached to the bladder or rectum. The cyst lining is a thin gelatinous membrane on which large numbers of hooklets are found. The cyst in many cases is firmly adherent to the adjacent organs, the bladder and rectum. The development causes a torsion of the posterior urethra and neck of the bladder so that catheterization is made very difficult. This fact was noted by many of the early contributors to this subject. It was very apparent in the author's case before the correct diagnosis had been made. Freund and Chadwick noted the elongation of the uterine cavity in their patients. The contents of the cysts are the same as in hydatid cysts in other parts of the body. They are filled with a homogenous jelly-like mass in which there are daughter and granddaughter cysts. Hooklets are not difficult to demonstrate from the fluid or membrane and often are the determining factor in the diagnosis.

Some of the interesting pathological findings are the result of the pressure of the cyst on the surrounding organs. Besides compressing the neck of the bladder pressure on the ureters has been seen. This was described by Tillaux, Ocampo, Wood, and many others. Hydro-ureters and hydro-nephroses were present in a large percentage of the autopsies, thus explaining uremia the immeditate cause of death. Pressure on the rectum is not an uncommon condition and the patients have frequently complained of difficult defecation.

Spontaneous rupture of the cyst occurred in 2 of the 48 cases; 1 into the rectum and another into the bladder. A number of writers describe the rupture of the cysts into the urinary bladder with the passage of blood, and cyst contents. Brun describes a patient in whom the cyst ruptured into the rectum; Sibelle a case which ruptured into the scrotum; Barret one draining through the uterine cavity.

Barret describes a most unusual condition in which the gall-bladder drained through the vagina, with the uterine cavity, Fallopian tube and hydatid cyst forming the intermediary tract for drainage. The cyst had apparently ruptured into the gall-bladder and the Fallopian tube thus establishing vaginal drainage to the gall-bladder.

The development of the hydatid cyst is slow, producing usually a chronic disease. Haskins estimated the growth to be 15 to 20 mm. in five months and makes the statement that if this is not interferred with it will cause a fatal termination in five years. It is certain that some become firmly walled off and grow very slowly as indicated by the clinical symptoms. Infection occasionally takes place spontaneously and causes a relatively rapid termination of the disease either by immediate death of the patient or rupture of the cyst into the rectum or bladder.

Symptoms

There is usually a long incubation period without any symptoms. The onset is then gradual and insiduous. It is not the symptoms of the cyst itself, but the effect of the pressure by the cyst on the adjacent organs that causes the patient to seek medical aid. The developing cysts of the hydatid may be likened to other cysts of the pelvic organs. Not until they reach a considerable size do they make themselves known. The chief symptom is the difficulty in urination. A few patients give a history of sudden onset of retention while most of them complain of a gradual development of difficult urination and finally complete retention. Frequency of micturition with hesitancy and straining is common. Hematuria has not been present except in the case reported by Funstenberg in 1890 in which the cyst ruptured into the bladder. Pyuria has been recorded in cases in which there were moderate urinary symptoms without complete retention. Pain in the bladder is due to the distension of the bladder by the pressure of the cyst on the bladder. Pain is often referred to the hypogastrium, perineum, or back. It is quite a constant factor and is usually severe. Other patients complain of a weighty disagreeable sensation in the lower abdomen and perineum. Rectal symptoms due to pressure of the cyst are not marked. Three patients complained of ribbon-stools and eight of constipation; cessation of menstruation was noted once. Uterine bleeding was a symptom in a patient where the cyst was located behind the uterine body. Gastrointestinal symptoms were noted where liver infection or peritonitis existed as a complication. Rupture of the cysts into the rectum causes frequent bowel movements with passage of cyst material. Suppuration of the cysts is characterized by elevation of the temperature and pulse, and by vomiting, emaciation and cachexia. Uremia was apparently present in some instances as indicated by vomiting and the development of coma before death.

Neurologic symptoms were present twice in the form of pain in the thighs and in the region of the sciatic nerve. Loss of weight and strength were noted only in the later stages of the disease. Urticaria is recorded in three instances. This was accompanied by general malaise, chills and fever which persisted for three or four days.

Abdominal examination. Revealed a large round smooth tumor which many times has been taken for distended bladder. Catherization does not affect this tumor much to the surprise of the operator. It remains immobile occuping usually the midline although three or four authors have referred to it as extending into an iliac fossa. There is very little pain in the abdominal examination. No mention is made of the possibility of shifting dulness in the flanks. Liver nodules were noted 5 times. These were found to be smooth, round, firm, and like the hypogastric tumors were dull to percussion. Two cases showed definite tenderness in the kidney regions. No mention is made of enlargement of the kidneys. The abdomen in a few instances was enormously enlarged. Barret's patient thought she was in the eighth month of pregnancy. General abdominal tenderness with muscle spasm was present in those patients developing peritonitis.

Rectal examination. Is definitely recorded in 28 cases. Most of the tumors were found to be smooth, round, hard and firm occupying the cul-de-sac. One or two were thought to be movable. The remainder were adherent to the rectum and prostate. Two were described as having a definite characteristic fremitus or "fremissement" as described by the French. Masmejean thought that this sign was pathognomonic for hydatid disease, but Legrand regarded it as a rare finding. This was elicited by bimannual palpation which unfortunately was carried out only rarely. In the chronic cases this sign is impossible to detect since the wall of the cyst is very thick and fibrous. Transmission of pressure from below to the abdominal tumor was not commonly experienced. In five patients the tumor was described as a bulging mass in the perineum at the margin of the anus and when near the surface the skin was red, tense and tender.

Urethra. Attempts to catheterize the bladder are often unsuccessful so that suprapubic puncture is immediately carried out. The catheter meets an obstruction in the prostatic urethra. Metal catheters were used in many cases without very much difficulty. Four writers record a twisting of the urethra: such a condition was marked in the author's case. A catheter usually passes readily to the prostatic urethra where it meets an obstruction and from this it deviates to the right or left and then transverses a much elongated posterior urethra. The neck of the bladder is displaced from its normal position by the development of the cyst. Obstruction to urination is caused by the pressure of the cyst. Catherization, however, does not cause the abdominal tumor to disappear so that a cyst is usually the diagnosis arrived at. Either a suprapubic or rectal puncture is carried out with the scape of characteristic hydatid material thus completing the diagnosis. In the female an elongation of the uterine canal 14 cm. was recorded by Freund and Chadwick. Uterine bleeding was noted by Tillaux once. Barret's cases drained hydatid material through the vagina. Brun reports a patient with spontaneous rupture into the rectum, shortly followed by a rectourethral fistula as indicated by the gas, pus and fecal material passing per urethram.

When suppuration takes place in the cyst, its walls become soft and friable. Patients develop elevation of temperature, pulse, and respiration. The death of the hydatid follows and the cyst is transformed into a suppurative pocket which makes itself known by extension or rupture. If rupture takes place into the rectum, diarrhea and constipation often alternate and the patient may recover. If rupture takes place into the peritoneum followed by a general peritonitis, death results in a few days. The author's case showed signs of a low grade peritonitis for several days before death. Lesauvage reports an interesting case with intestinal obstruction due to the cyst rupturing into the abdominal cavity. The patient vomited much fecal material, became comatose, and died.

Diagnosis

The diagnosis is difficult because of the combination of symptoms. In the male the urinary symptoms are the salient features of the history while in the female menstrual disturbances associated with complete obstruction to urination are the essential factors. The palpation of the rounded, smooth tumor in the hypogastric region has always been diagnosed as a distended bladder. In some instances the tumor is the bladder and in others it is the hydatid cyst, but the differentiation is not made by palpation alone. Rectal examination is most valuable in disclosing a round, smooth, hard, firm tumor situated between the bladder and rectum. It is not tender unless it has become infected. The fremitus of the hydatid cyst is recognized as a pathognomonic sign, but it is rarely detected. The greatest error lies in the fact of retention of urine and the palpable abdominal tumor which resembles a distended bladder. Catheterization whether successful or not, often leaves the physician in doubt. The elongation of the bladder neck with torsion was noted in 4 cases. Difficulty in catheterization is nearly always present. In 3 cases the catheter was passed directly through the cyst wall being followed by the escape of hydatid material. The increased length of the uterine cavity is mentioned in 2 out of the 7 female patients.

Suprapubic puncture of the bladder for relief of symptoms was attempted and much to the surprise of the operator the fluid from a cyst escaped. Rectal punctures were frequently carried out for diagnosis. I would criticise such a procedure: First, because many of the patients so treated become infected, develop a peritonitis and die; and second, because the same result can be accomplished by inserting a long needle through the perineum directly into the cyst under local anesthesia with aseptic precautions. With the finger in the rectum as a guide the needle can be easily directed. This procedure was easily carried out in the author's case, the cyst contents obtained and the cyst injected with thorium. Large amount of pus was obtained showing B. coli. This infection was probably produced by a rectal puncture a few days previous to admittance to the Clinic.

Where there exist other tumors such as those of the liver a differential diagnosis must be made between echinococcus and malignant disease, with metastases in the liver. Cysts in the pelvis of man are rare. Occasionally sarcoma has the characteristics of the hydatid. Cysts developing from the utricle reaching the size of the hydatid are occasionally encountered.

Where there are signs of infection a large prostatic or seminal vesicle abscess is a likely diagnosis. Potherat considered as a possibility a large diverticulum of the bladder containing a stone. This, however, could well be ruled out by X-ray. A diverticulum of the upper portion of the rectum or lower sigmoid or a malignant tumor which had perforated the wall might be considered and possibly ruled out by a bismuth enema. Such a procedure was used in the author's case. A constriction of the bowel in this region was demonstrated by a bismuth enema, due to the pressure of the tumor. Pelvic sarcoma is the most common mistake in diagnosis. In woman a fibroma, ovarian tumor, growth of broad ligament, cysts of the tube, are common pre-operative diagnoses, but correct diagnosis is not made until exploration is carried out. In a number of cases seen in a country infected with hydatid disease, echinococcus was suspected, because of the insiduous history, and characteristic smooth, round, elastic, firm, adherent, tumor, not accompanied by tenderness or any change in vital signs. But in a country where this disease is rare and the obstruction to urination occurs in only 1.7 per cent of all cases, the diagnosis is difficult without some operative procedure such as either a perineal puncture or suprapubic exploration. The history of a liver tumor, associated with some accident, which is immediately followed by peritonitis and later by the development of a pelvic tumor causing obstruction to urination, should be very suggestive of a hydatid cyst. The compliment fixation test when available should not be forgotten.

Treatment

The treatment of hydatid cyst giving complete urinary obstruction may be divided into two parts, namely, the relief of the bladder distention and the disposal of the cyst or its contents. Only the first was carried out in many cases because of the error in diagnosis. Spontaneous rupture of the cyst into the bladder in one case and into the rectum in another with complete recovery occurred. The cyst was emptied thus relieving the pressure on the neck of the bladder. The urine caused death of the hydatid in the instance of the rupture into the bladder and the secondary infection from the rectum caused a similar effect in the latter case.

Puncture. A suprapubic puncture of the bladder was carried out in 5 patients all of whom died. It is not certain from the notes whether they developed a peritonitis or whether death was due to uremia from pressure of the cyst on the ureters. Diagnosis was not made in any of these cases previous to necropsy.

TABLE 2

	NUMBER OF CASES	CURED	DEAD	INCONTINENCE OF URINE	IMPROVED
Number cases not treated	7		6	1*	
Spontaneous rupture into bladder	1	1	–		
Spontaneous rupture into rectum	1	1	–		
Puncture-suprapubic bladder	5	–	5		
Puncture-suprapubic cyst (twice)	1	1	–		
Puncture rectum	6	–	4	1	1
Colpotomy	2	1	1		
Incision abdominal—drainage	1	–	1		
Incision abdominal—drainage and suture of cyst to abdominal wall	7	7	–		
Incision perineal	6	4	2		
Incision rectal	2	2	–		
Transvesical drainage of cyst	1	1	–		
Extirpation of cyst	1	1	–		
Marsupialization of cyst	3	3	–		
Suprapubic and perineal drainage	3	2	1		
Suprapubic bichloride lavage of cyst and tight closure	1	1	–		
Total	48	25	20	2	1

* Refused operation.

Duplay obtained an excellent result by two suprapubic punctures of a cyst. There is no mention of irrigating the cyst cavity or how long the case was under observation after leaving the hospital. The punctures were made four weeks apart.

Puncture of the cyst through the rectum was carried out in 6 cases with the result that 4 died, 1 developed incontinence, and in the other a fistula persisted discharging hydatids. The diagnosis was not made in any of these, although it was considered a possibility by Valpeau. The author's case had experienced a rectal puncture previous to admission. Rectal puncture alone is considered to be dangerous as it affords an avenue for infection which in turn causes a degeneration of the cyst wall and breaking down of the natural barriers for the limitation of infection. The cyst either ruptures into the pelvic or abdominal cavity and a peritonitis soon follows. The four patients with rectal puncture all died and showed at autopsy peritonitis. Rectal puncture and rectal incision were carried out successfully by Dolbeau thus giving free drainage to the cavity.

In 2 of the female cases a puncture through the vaginal vault was done. The second case developed bladder, vaginal, and rectal fistulae and died after months of lingering illness.

Incision of the cyst. Simple abdominal incision and drainage of the cyst was unsuccessful in 1 case inasmuch as the patient died of general peritonitis a few days later. The peritoneum and bladder were both opened at the time of operation.

Suprapubic incision with suture of the walls of the cyst to the walls of the incision was most encouraging. Seven cases were treated by this method with 100 per cent cures. This gives permanent free drainage to the cyst without infection to the peritoneal cavity. It also allows irrigation with antiseptics and what is still more important the healing from the bottom of the pocket. This method is especially advised where there are many adhesions to the adjacent organs and where it would be dangerous to attempt complete removal of the cyst. The average time for healing is eight to ten weeks. One case reported by Cranwell healed in sixteen days. He used strong formaldehyde solution for lavage of the cyst cavity at time of operation. In other instances bichloride and carbolic solutions were also used in 1:200 strength.

In 6 patients perineal incisions were made with 2 deaths and 4 cures. The deaths were from general peritonitis. Those recovering drained through the fistula for an average of eight weeks.

Rectal incisions giving free drainage were successful in 2 cases. The details of these cases are not given; but it is assumed that a long incision was made in the anterior wall of the rectum.

A combination of suprapubic and perineal drainage was instituted in 3 patients. Two recovered and 1 died. The autopsy of the 1 showed dilated ureters and hydatid cysts in the liver. This patient undoubtedly died of uremia.

Transvesical drainage was done by Fünstenberg with healing of the wound, but there was a recurrent tumor found later in the abdomen.

Marsupialization was successfull in 3 instances in three weeks, six weeks and ten months, respectively. One would expect a quicker healing time in these cases than in those where the membrane was allowed to remain in position. The one showing the longest healing time did not have adequate drainage.

Total extirpation of the cyst can rarely be accomplished except in those patients where it is not adherent to the adjacent organs. Marion was able to do this in 1 instance with an excellent result.

Getten in 1898 incised a cyst through the abdominal wall, irrigated it with strong bichloride solution and then sutured the wound tightly with no untoward results. The wound healed per primum and the patient left the hospital in sixteen days. This would seem to be a commendable method where there is no infection and if there is no danger of bichloride poisoning, this being an unknown factor and one of which cognizance should be taken.

Treatment then seems to depend mostly on the accurate diagnosis and the incision and drainage of the cyst. The urinary condition corrects itself shortly after the cyst is drained. The best results are those obtained by suprapubic incision of the cyst and suturing the wall of the cyst to the wall of the abdominal incision. Where there are also cysts in the liver there is no reason why these should not be treated in the same manner. Vellar treated such a case successfully. The problem of infection is a serious one. Suprapubic and rectal punctures are to be deplored as they open the pathway of infection and many lead to a peritonitis. Perineal incisions may be used if the cyst is low down near the perineum. Marsupialization can be commended highly as it does away with any possible recurrence of the hydatid. If the walls of the cyst are sutured to the wall of the wound the results should be equal to any other method and the convalescence shortest of any of the treatments involving incision and drainage.

COMPLICATIONS

The complications of pelvic hydatid cysts causing complete obstruction to urination are mainly three: (1) infection, (2) uremia, (3) other cysts. It is quite certain that some of the cysts became infected spontaneously and the patient thus developed peritonitis. Others were produced by suprapubic or rectal punctures. All patients developing a peritonitis due to secondary infection terminated fatally as indicated by autopsy which was done in all cases. The necropsies are not all given in detail but 9 out of the 20 showed dilated ureters and pelves of the kidney caused by pressure of the cyst. The clinical pictures described are those corresponding to uremia. Charcot stated that cases complicated by cysts of the liver had a bad prognosis—10 of the 20 cases which died showed cysts of the liver.

PROGNOSIS

Of the 48 cases with complete urinary obstruction due to hydatid cyst 7 were not treated; 25 of the 41 patients treated recovered; 14 died; 1 developed incontinence and 1 was improved. Of those operated upon, 60.9 per cent were cured and 34.1 per cent died; 5 per cent developed fistula or some other chronic condition. Error in diagnosis is responsible for at least 50 per cent of the mortality, while secondary infection produced by suprapubic or rectal puncture is responsible for 40 per cent of the deaths. The prognosis should be good for all those patients which have free drainage of the cyst before infection or uremia develop. Multiple cysts indicate a bad prognosis unless they can be drained easily.

CONCLUSIONS

1. Complete urinary obstruction due to hydatid cyst is rare in America.
2. Pelvic hydatid cysts occur in 3.8 per cent of hydatid infections, most of which give urinary disturbance; but only 1.7 per cent cause complete retention of urine.
3. Total urinary obstruction due to hydatid is most common between the twentieth and fortieth years.
4. The male is more prone to develop urnary obstruction, the ratio being 6:1.

5. Spontaneous rupture of the cyst into the bladder or rectum is not fatal.

6. Suprapubic puncture of the bladder or rectal puncture of the cyst to relieve the distended bladder should not be carried out.

7. Perineal puncture of the cyst for diagnosis can be done effectively.

8. Marsupialization of the cyst is the method of choice for treatment.

9. Incision of the cyst with suture of the cyst wall to the edges of the abdominal wound gives good results.

10. Infection of the cyst is frequently followed by peritonitis and ends in a fatal result.

11. Prognosis is good where the cysts are single and remain free from secondary infection.

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HYDRONEPHROSIS[1]*

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Instances in which a hydronephrosis exists associated with an abnormality of the renal blood supply in which an anomalous artery crosses the ureter just at its junction with the pelvis have been recognized for several decades. The prevalent idea today is that such an abnormality is a rare one differing in no marked essential from other varieties of hydronephrosis; but a more careful study of the subject would seem to indicate that cases of this sort are not very infrequent; while examination of the clinical histories makes it evident that they form a class showing a strikingly definite symptomatology. Besides the present day failure to recognize these cases there is frequently further failure to apply the ideal type of treatment when the condition is found at operation. For these reasons a renewed discussion of such hydronephroses is to be desired.

ANATOMICAL CONSIDERATIONS

It is well known that anomalies of the arterial blood supply to the kidney are frequent and various. Though normally a single renal artery enters the renal hilus this may be doubled due to early branching, or there may be a double artery throughout the whole extent from aorta to kidney. Of more interest are those instances in which the vascular supply does not enter the kidney at the hilus only but at either one or both poles. There may or may not be a vessel occupying the normal hilus position under these circumstances. When there is a polar vascular supply the artery going to the lower pole is frequently found in close relation to that portion of the renal pelvis which is nearest to the ureter. Here the artery may maintain its normal position anterior to the pelvis or it may run posteriorly, or in some instances in which there are two vessels entering the lower pole of the kidney, they may run on each side of the pelvis.

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The central origin of such anomalous vessels has been found to be variously from the aorta itself as an independent branch, or even from the spermatic, ovarian, or iliac arteries. It will of course be readily recognized that such anomalous vascular distribution to the kidney is a persistence in part of the earlier fetal condition normally present in the mesonephros, and that with the final ascent of the kidney to its position in the renal fossa some of the blood vessels which are normally absorbed have failed to become so.

PATHOLOGY

On examination of the conditions present in cases of this type which have not become complicated by any incidental factor such as infection, the outstanding feature is the dilatation of the pelvis of the kidney which is always considerable, varying in our cases from about 200 cc. to a liter in cubic contents. Section of the pelvis shows that its wall has undergone distinct hypertrophy. At the outlet of the pelvis into the ureter there is neither stricture nor valve formation, and the orifice of the ureter is not pulled upward onto the side of the pelvis but is found as a rule in nearly its normal position. Just at the junction of ureter and pelvis is found in very intimate relation to these structures the aberrant vessel above mentioned and this may be accompanied by one or two associated veins, the whole making up a very definite band-like structure. The size of the artery apparently varies considerably from one so small as to be of only very minor significance as a carrier of blood to the kidney, up to a size somewhat larger than the radial, which it is evident carries at least one-half of the total blood supply. The plexus of sympathetic vasomotor nerves which is normally found entering the renal hilus closely adherent to the artery, is not evident in association with the anomalous vessel to the lower pole except in those instances where there is no vessel at all entering the hilus, when nerves can plainly be seen along the course of both upper and lower polar arteries.

The parenchyma of the kidney is found thinned to a greater or lesser degree according to the extent to which the hydronephrotic process has progressed. It is thrown into bosses representing externally the dilated calyces within. All grades of thinning and flattening of the tubules occur corresponding to a renal function which though but moderatly reduced in the less severe cases, may often represent a transformation of the cortex and medulla into a functionless shell.

Examination of the ureter finds it free from dilatation or other abnormality so soon as it emerges from its immediate relationship with the aberrant vessel.

The following histories are illustrative of this condition.

Case 1. No. 6367. A single man, aged nineteen, entered the hospital March 5, 1917, complaining of attacks of pain in the left side. These began two years before entry, and occurred irregularly about once a month. During six months before entry the pain had become more severe, lasting from two to five days and forcing the patient to stay in bed. It was a dull steady pain in the region of the left costal margin and costovertebral angle, radiating sometimes to the back, and occasionally accompanied by nausea and vomiting. The patient's health had always been excellent otherwise. His physical condition was splendid and he was actively at work in an agricultural college. Repeated examination of the urine by his attending physician had shown no abnormality other than a slight trace of albumen and an occasional leucocyte.

On physical examination there was tenderness in the left costovertebral angle, and on palpation a smooth, tender, very much enlarged left kidney was felt. There was some muscle spasm in the back. Over the left flank were found scars of an old herpes zoster.

The admission specimen of urine was of normal color; acid reaction; specific gravity, 1021; a very slight trace of albumen, and no sugar. A few red blood cells were found in the sediment.

Cystoscopy showed the urethra and bladder to be normal. The urine from the right side was normal; that from the left side was seen by microscope to contain an occasional red and white cell. The output of phenosulphonephthalein in one hour from the right side was normal, while from the left there was only a trace. Injection of thorium solution followed by x-ray showed a marked dilatation of the left kidney pelvis.

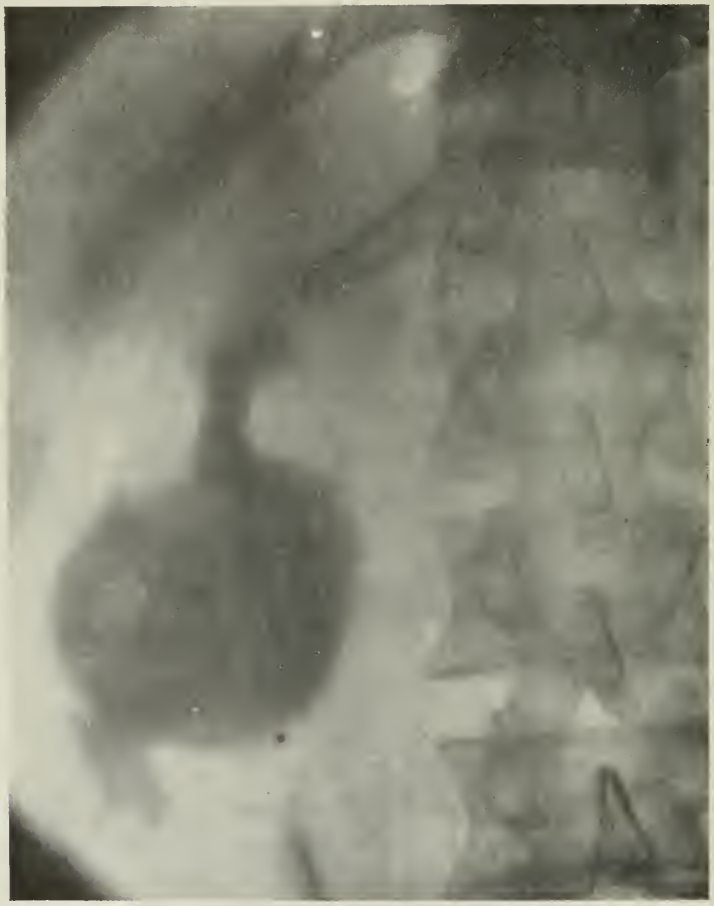

Fig. 1. Case 1. Pyelogram Before Operation

On March 6, 1917, the left kidney was explored at operation. After penetrating the perirenal fat which was present in normal amount and

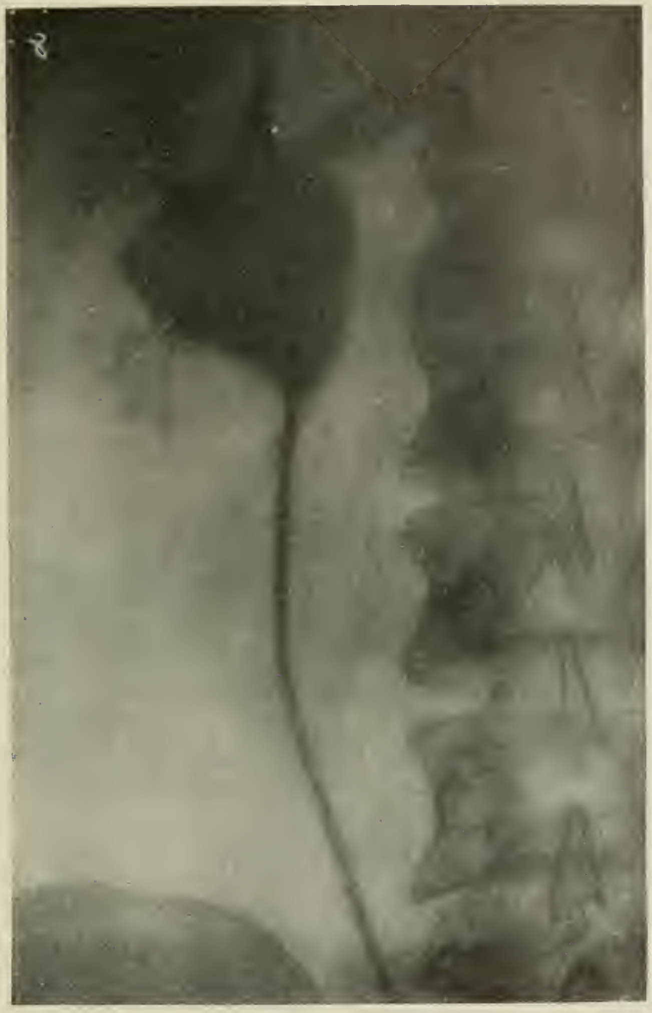

Fig. 2. Case 1. Pyelogram a Year After Operation

Note the diminished size of the pelvis and the funnel-shaped outlet into the ureter.

consistency, the kidney was exposed and found to shell out readily from its fatty capsule. The organ was of good size, rather longer and narrower than normal. In the region of the pelvis there existed a large, globular tumor possibly 8 cm. in diameter, which occupied the region normally containing the hilus. On investigating the blood supply of this kidney it was found to come from two separate arteries entering at either pole, there being no arterial vascular supply in the equator of the organ. The lower renal artery crossed directly from a direction of above outwards and downwards, in front of the junction of the ureter with the distended pelvis. Because of the size of the pelvis it was impossible to manipulate the kidney in satisfactory manner so that it was necessary to withdraw its contents by aspiration with the needle; 230 cc. were evacuated. Following this an attempt was made to deliver the kidney onto the surface, but this was impossible on account of the shortness of the arteries. A careful dissection was then made of the uretero-pelvic junction. The lower polar vessel was entirely freed from this region and lifted upwards. On the posterior side of this junction a few strands of fairly firm, fibrous tissue were excised. The large, baggy pelvis was then opened by a long incision on its posterior surface running from the region of the renal hilus down nearly to the ureter. On exploring through this it was found that there was no valve-like condition at the entrance of the ureter, but this opening looked, as seen from the inside, rather puckered. The edges of the incision in the pelvis bled rather freely, undoubtedly due to the release of tension by evacuation of the contents. A plastic suture was done on the uretero-pelvic junction by cutting down for about 2 cm. on both sides, that is, on the side of the ureter as well as on the side of the pelvis. This incision penetrated all walls and was reunited by fine catgut stitches, working from the outside; the incision being sewn together in a direction opposite to that in which it was made after the manner of the Heineke-Mickulicz pyloroplasty. The incision in the body of the pelvis was then closed by interrupted fine catgut sutures. The kidney was replaced high under the ribs and held there by one suture of silk, passing through the organ on its posterior surface just above the midline, being tied above the twelfth rib. This anchored the organ firmly in the position from which it had been freed. The muscles were closed with chromic catgut and the skin with silk, a drain being left in as far as the region of the pelvis over which there had been apposed a small bit of perirenal fat. Examination of the renal parenchyma showed that there was a very considerable amount of good kidney tissue present which it would have been unwise to sacrifice by nephrectomy, unless adequate drainage could not be attained by the procedure just described. The patient's convalescence was uneventful, and he was discharged in good condition thirteen days after operation.

A subsequent examination on August 8, 1918, showed that the renal function was within normal limits from each kidney. A pyelogram showed that the pelvis had not retracted to its normal size, 25 cc. being injected without pain, but its outlet was funnel-shaped and the kidney seemed to have much better drainage than before. Since operation there had been no pain whatever and the patient was in excellent health.

Case 2. No. 10848. An unmarried college student nineteen years of age entered the hospital July 17, 1919, complaining of attacks of pain in the left side of the abdomen. This pain had been present, intermittently, for three and one-half years, and was localized under the ribs and in the dorso-lumbar region. The attacks came on suddenly, were very acute, and lasted several hours. Between attacks the patient had very little pain. Occasionally there was an attack of pain on the right side similar to that felt on the left. In January before his admission the patient had an unusually severe attack of pain, accompanied by vomiting. He had also been subject to attacks of vertigo, not associated with the pain, which were accompanied by slight gastro-intestinal disturbances. The patient attributed the onset of these attacks of pain to a fall which occurred while he was swinging by his finger-tips from an upper stair landing in his home. He fell heavily onto the stairs below, striking his left lower ribs and back. Previous to these attacks of pain, and when they were absent, his health was splendid and he indulged freely in all forms of athletics.

On physical examination there was found spasm on both sides of the abdomen together with pain on pressure in the region of the left kidney. Neither kidney could be palpated.

The admission specimen of urine was of normal color; alkaline in reaction; with a specific gravity of 1014. There was a slight trace of albumen, but no sugar. There were many red blood cells, no casts, and a rare white blood cell. On cystoscopic examination the specimen of urine from the left side contained a few white cells, while that from the right was normal throughout. The phenolsulphonephthalein output from the right side was 25 per cent in fifteen minutes; that from the left side was but a trace.

A pyelogram of the left kidney showed the pelvis and calyces to be enormously dilated. The right kidney showed similar, but less marked changes.

On July 23, 1919, the left kidney was exposed. The renal fossa was found to be filled by a large, tense mass. On further investigation the kidney proper was seen to be much increased in size, especially in the longitudinal direction, and to lie outside and posterior to a second large, tense, fluctuant swelling which extended from the kidney toward the midline of the body. This was carefully separated from the posterior surface of the peritoneum and found to be a very markedly

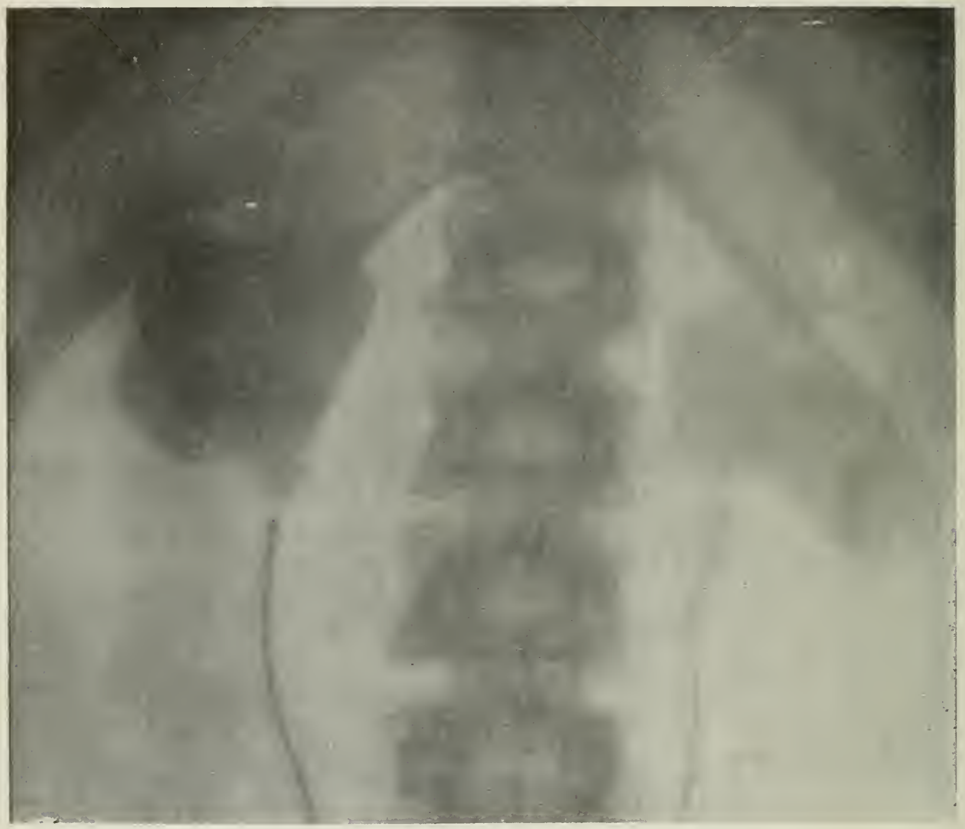

FIG. 3. CASE 2. BILATERAL PYELOGRAM SHOWING HYDRONEPHROSIS ON EACH SIDE

dilated pelvis possible 12 x 14 cm. in diameter lying anterior to the vessels. Investigation of the ureter showed that this was practically of normal size and that the obstruction lay at the junction of the ureter with this enormously dilated pelvis. In order to make further exploration possible the contents of the pelvis were evacuated by a blunt trocar and tube, over 500 cc. of opaque urine being withdrawn. Further investigation demonstrated clearly that the condition suspected before operation was in fact present, namely, that the kidney had a polar blood supply and that there were two arteries, one reaching the kidney at its upper pole, the other at its lower pole. The upper artery was only palpated; it could not readily be seen on account of its shortness and inability to remove the organ from the renal fossa. The lower artery was accompanied by veins and ran anterior to the ureter intimately connected with it by fibrous tissue. Its size was somewhat larger than that of the radial. At this point the obstruction occurred. The ureter entered the dilated pelvis exactly at its most dependent portion and no carrying up of the ureter on to the side of the pelvis could be demonstrated. In other words, there was no valve formation present. It became evident after complete exploration that no method of freeing the obstruction short of transplantation of the ureter would be successful. The vessels, of course, could not be severed because of fear of destruction of the lower half of the kidney. The ureter was therefore tied just below the lower renal artery and cut across. It was then brought forward and upward and after bevelling its proximal end, was united to the pelvis by interrupted stitches, a longitudinal incision about 1.5 cm. long having previously been made in the pelvis for this purpose. Four retaining sutures of the finest catgut were used through all the coats of both pelvis and ureter and the space between these closed by interrupted stitches of fine silk which did not penetrate the mucosa. After the suturing had been completed the ureter lay in good position being united to the pelvis in an oblique angle, its upper end being a little more dilated than the main trunk of the tube. There seemed to be a little redundancy in length of the ureter and it was attempted to control this by lifting the kidney high and fixing it by suturing over the last rib. The sutures, however, did not hold well, and this attempt was later abandoned, the kidney being decapsulated for a short area over its posterior surface and held up under the ribs by a cigarette wick which was packed in at the lower pole of the organ in the general direction of the suture, but not touching it. The patient made an uneventful recovery and was discharged eleven days after operation, there having been practically no leakage of urine from the wound.

During the three years which have elapsed since operation I have been in frequent communication with the patient and his family. There has been no return of pain and his health is normal.

Case 3. No. 10335. A young woman of twenty-two years entered the hospital on April 21, 1919, complaining of pain in the right side.

This pain, which had commenced ten years before entry, was at first dull and intermittent and well localized in the right lumbar region. The attacks were sometimes accompanied by slight feverishness. Six months before entry the pain became more marked, and two months later darting pains appeared on the left side in a region corresponding to that where the dull pain occurred on the right side. Attacks of these pains occurred about twice a week, lasting ten to fifteen minutes. The urine had been cloudy for six months, and between micturition there was occasional burning in the urethra. The urine contained "strings," but there was no difficulty in control; no urgency, inconti-

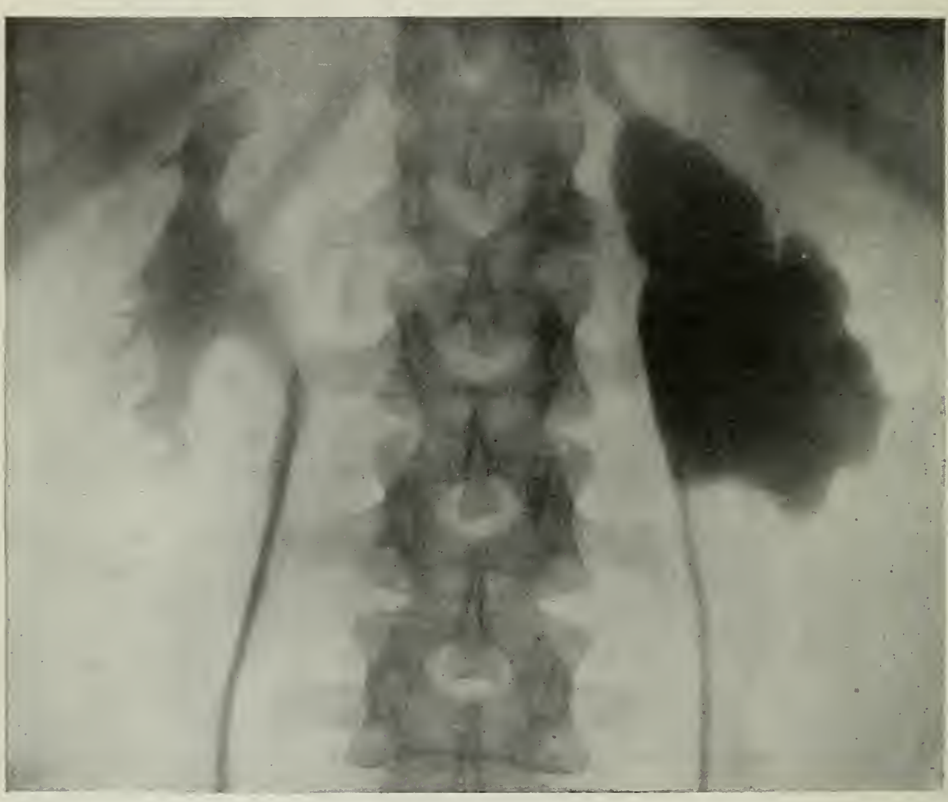

Fig. 4. Case 3. Bilateral Pyelogram Showing Extreme Destruction of the Kidney on One Side by Dilatation with Normal Pelvis on the Other Side for Comparison

nence, nocturia, or hematuria. There may have been slight loss in weight.

Physical examination found the abdomen to be tympanitic except in the left lumbar region, where there was slight tenderness. The catheter specimen of bladder urine was clear, amber in color with a moderate number of epithelial cells, and 4 to 8 white blood cells per high power field. Smears from the left kidney and bladder sediment were negative for tuberculosis. Inoculation of a guinea pig demonstrated no signs of tuberculosis. A culture of the bladder urine was sterile.

The x-ray examination showed both kidneys to be indistinct. There were no shadows in any part of the genito-urinary tract that could be interpreted as stones.

The patient was discharged April 29, 1919, and reentered the hospital April 27, 1920. Since discharge she had felt definite discomfort in the region of the right kidney which was distinctly influenced by motion or change of position. For instance, after sleeping on her face she would be awakened after a few hours by this definite pain. She had also experienced a sore sensation over the bladder which was especially uncomfortable when she was sitting down.

Pyelograms taken one day after readmission showed a marked hydronephrosis of the right side, the kidney occupying its normal position. The outline of the right kidney was not shown. With the patient standing there was only the normal change of position of the kidney. The outline of the left kidney was distinctly shown occupying its normal position. The pelvis and calyces were completely injected and were normal.

On May 1, 1920, the right kidney was exposed. On enucleation its cortex was found to consist only of a thin shell of tissue divided into various lobules. Its pelvis showed dilatation similar to that seen in the pyelogram. The ureter was not dilated. On investigating the blood supply of this organ, a branch of the renal artery was found entering the lower pole of the kidney and occluding the ureter by adhesive tissue. This vessel was very nearly the same size as the main renal artery itself. The renal artery entered the hilus of the kidney in a normal fashion. Since there was no value in the remaining kidney tissue a nephrectomy was carried out, vessels and ureter being tied as usual. The wound was closed by a double layer of muscular stitches and silk in the skin.

The patient made a good recovery from operation, and was discharged on May 15, 1920, after an uneventful convalescence. When last heard from in February, 1922, she was well, and feeling much better than she had felt in the past.

Pathological report. Material: kidney. May 1, 1920.

Gross description. Specimen consists of a shrunken and misshapen kidney which measures 8 cm. in length, 6 cm. in its greatest portion, and 2 cm. in thickness. Externally the pelvis is seen to be markedly dilated. Parenchyma is thin and shrunken. On the external surface it is 1 to 1.5 cm. in width while the pelvis externally is 5 cm. in greatest width. On palpation the organ is found to be cystic. Parenchyma apparently has almost entirely disappeared, being represented by a thick shell of tissue, the pelvis being much dilated and filled with clear urine. At the lower pole of the organ are found the stumps of an artery and vein which, if projected outward, would come in close proximity with the origin of the ureter at the lower pole of the pelvis. There is also an artery and vein of normal size seen in the usual position. On introducing a probe into the cut end of the ureter it is found to pass readily into the pelvis.

Diagnosis. Hydronephrosis.

Microscopic report. Cortex is thinner than normal. Many glomeruli show partial or complete hyalinization and a few show dilatation of subcapsular space. There is increase of interstitial tissue with definite scarring in places. Tubules show varying degrees of change, there being atrophy, hyalinization, edema and occasional dilatation. Practically all tubules contain hyaline or albuminous material.

Diagnosis. Hydronephrosis; polar vascular supply of kidney.

Case 4. No. 15194. A girl of fourteen entered the hospital September 15, 1921, complaining of attacks of dull pain in the left lumbar region. These attacks had been present for one year, and occurred about every ten days, confining the patient to bed for one to three days. They were accompanied by loss of appetite, with vomiting which bore no relation to meals, and a slight decrease in the amount of urine voided. One to two days following an attack the patient noticed an increased output of urine.

The physical examination was negative except for slight tenderness in the left lumbar region, and slight fullness in the costo-vertebral angle. Urine analysis showed: Slight trace of albumen; reaction, acid; specific gravity, 1016; color, normal; sugar, none. The output of phenolsulphonephthalein was 40 per cent. Pyelography showed extreme dilatation of the pelvis of the left kidney. The phthalein output from the right kidney was 15 per cent in ten minutes, and there was only a trace of dye from the left kidney. The microscopic examination of the urine was negative. A diagnosis of hydronephrosis was made, and the patient discharged September 17, with the advice to return soon for operation.

When the patient reentered the hospital on October 5, 1921, the urinalysis showed: Color, yellow; reaction, acid; specific gravity, 1010; albumen, none; sugar, none; a few epithelial cells, and 5 white blood cells per high power field.

On October 10, 1921, a plastic operation was performed on the left kidney. The kidney was exposed in the usual manner and found to be about four times larger than normal, most of the enlargement being due to a dilatation of the pelvis as seen in the x-ray. The surface of the kidney, although lobulated, was otherwise normal and free from unusual adhesions to the surrounding structures. On account of the large size of the pelvis this was emptied by a small knife puncture after which exploration was much more easily carried out. Investigation of the junction of the pelvis with the ureter showed at this point an anomalous condition of the artery, there being two vessels, one running in front, the other behind this portion of the pelvis, intimately related to it and entering blindly the lower pole of the kidney. The blood supply represented by these two vessels, judging by their caliber, was considerable, and it was therefore felt unwise to divide them, if this could be avoided. Nephrectomy also seemed unwise in the presence of so large an amount of good kidney tissue. The condition was therefore treated by section of the ureter transversely just below the pelvis, after which the whole pelvis itself was brought into a position posterior to all the vessels. The segment including the area of vessel-crossing was excised from the pelvis and this wound closed completely by interrupted sutures of fine chromic catgut. The upper end of the ureter was then split downwards on one side by scissors for a distance of about 1 cm., and the expanded end thus obtained was in turn sutured to a new incision in the kidney pelvis made in that position which seemed to be most dependent after the pelvis had been brought into an entirely posterior position. The suturing here was also done with fine catgut.

The patient's convalescence was uneventful there being no leakage of urine from the wound after twenty-four hours. She was discharged in good condition thirteen days after operation.

Pathological report. Material: tissue from ureter. October 10, 1921.

Gross description. Specimen consists of a bell-shaped piece of reddish tissue measuring 1 cm. in length, 1.2 cm. at the base and 5 mm. at the apex. The bell portion of the specimen when everted is seen to be slightly elliptical in shape and has what appears to be mucous membrane on its inner surface. It is slightly injected. Through the central portion can be passed a small probe which emerges at its distal end without difficulty. Externally the specimen is bright red as a result of operative trauma. The appearance of the specimen on cross section is grey and glistening.

Microscopic report. A cross section of the distal end of the specimen shows a stellate-shaped lumen lined with stratified squamous epithelium similar to that of the pelvis of the kidney. The wall is made up of longitudinal and circular muscle bundles and shows no increase of connective tissue or other changes that would suggest a chronic inflammation. A longitudinal section through the proximal portion shows structure quite similar to the above. A few mononuclear cells and polymorphonuclear leucocytes are, however, seen in the submucosa.

Diagnosis. Normal ureter.

Case 5. No. 16202. A young woman of thirty, single, a private secretary by profession, entered the hospital March 5, 1922, complaining of pain in the right upper quadrant. The past history was unimportant except for the onset of this pain when the patient was fourteen. When she was fifteen an operation on the kidney, probably a suspension, was performed. This gave no relief and the patient continued to be troubled by attacks of pain and dull discomfort in the kidney region, not associated, however, with either vomiting or urinary symptoms. Ten years previous to admission the kidney was explored again and at the same time the appendix was removed through a second incision. Following this the patient was very comfortable until one year before admission when she experienced attacks of pain similar to those formerly felt. These attacks recurred at irregular intervals of several weeks, and began with dull discomfort, usually beneath the right costal margin, increasing until there was a marked ache throughout the right upper quadrant. Coincident with the ache there was frequently a feeling of fullness in the right hypochondrium relieved by lying upon it at night. There were no urinary symptoms, but during the attacks the patient could feel a lump in the right upper quadrant which disappeared when the attacks were over.

Physical examination was entirely normal upon admission, but the following day a characteristic attack developed, at which time a well-defined mass could be felt beneath the right costal margin in the anterior axillary line. Temperature, pulse, and respirations were normal. The admission specimen of urine was pale in color and cloudy; reaction, acid; specific gravity, 1007; albumen, none; sugar, none. There were

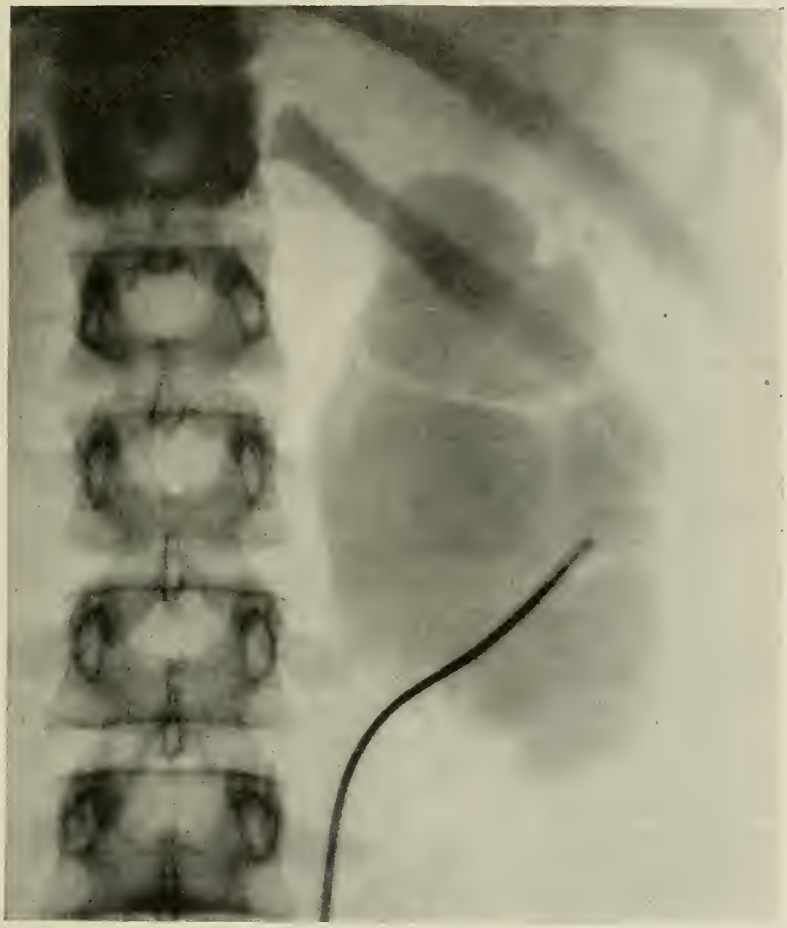

Fig. 5. Case 5. Note that the Catheter Passes Readily into the Hydronephrotic Sac which is Greatly Dilated

rare white blood cells and red blood corpuscles; no casts. The phenolsulphonephthalein output was 55 per cent in two hours.

At cystoscopy on March 7 the bladder urine was pale and slightly hazy, showing an occasional white blood cell and red blood cell. The urine from the left kidney was pale and clear with an acid reaction, showing 6 to 8 epithelial cells, 4 to 5 white blood cells and 1 to 3 red blood cells. The output of phenolsulphonephthalein from this side was 6 cc. in ten minutes. The urine from the right kidney was reddish-yellow, showing only blood on microscopic examination. There was no function on this side.

X-ray on March 7 showed distinctly the outlines of the kidneys with a catheter in situ on the left. A pyelogram showed no evidence of the pelvis or calices, the shadow of the injected fluid being so faint as not to outline them.

At operation on March 9 there were found very extensive, dense adhesions between the kidney and its surrounding tissues, together with a marked dilatation of the renal pelvis. On freeing this there was found a vessel certainly as large, if not larger, than the radial artery crossing the ureter and entering the kidney at its lower pole. Examination of the parenchyma showed that it was almost entirely converted into a shell of tissue, probably of no functional value. Nephrectomy was therefore done in the usual manner.

The patient had an uneventful convalescence and was discharged in good condition two weeks after operation. She was seen again the end of April when she appeared to be very well.

Pathological report. Material: right kidney. March 9, 1922.

Gross description. Specimen consists of a hydronephrotic right kidney. The capsule has been removed. The pelvis of the kidney measures about 8 cm. in diameter. The kidney substance itself measures about 6 x 3 x 3 cm. An aberrant artery enters the lower pole slightly on the anterior aspect, accompanied by a small vein. This artery, coming anterior to the ureter, has evidently been the source of obstruction. The main arterial supply enters the pelvis of the kidney in the usual manner. The pelvis of the kidney was distended with Kaiserling solution and the whole kidney immersed in the same fluid for preservation as a gross specimen. No tissue was taken for microscopic study.

Diagnosis. Hydronephrosis.

Case 6. No. 16228. A young girl aged fourteen entered the hospital March 9, 1922, complaining of frequent attacks of dull pain in the left side. The family history and past history were unimportant. The present symptoms began three years before admission and consisted of a dull ache in the left lower back radiating through to the abdomen. The pain was occasionally sharp, but characteristically dull and accompanied by tenderness of the abdomen and left costovertebral angle and lumbar region. Lying on the right side aggravated the attack. During the past year the attacks which occurred every week were accompanied by nausea and the vomiting of bile, which recurred at short intervals for twenty-four hours. Seven months before entry the patient was operated upon at another hospital for

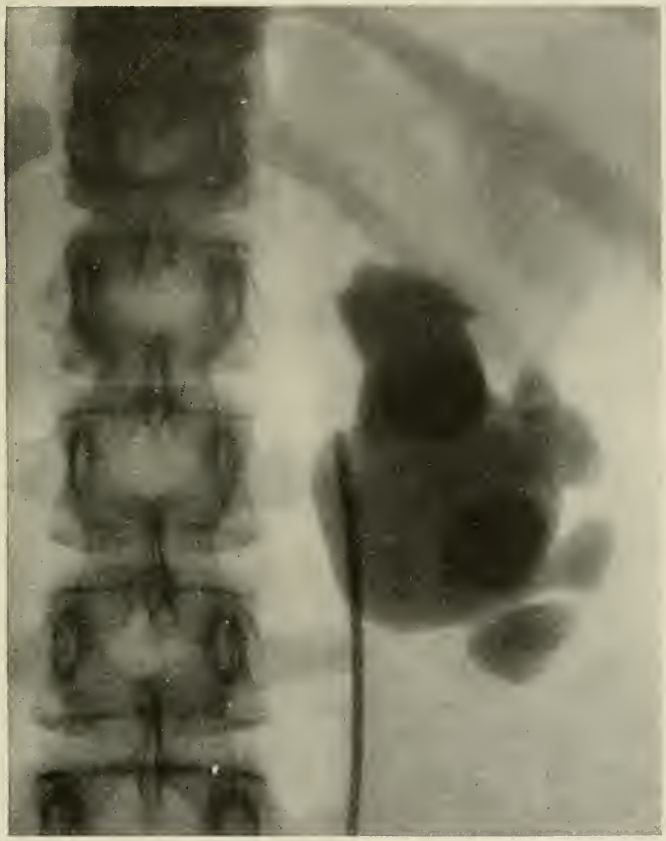

Fig. 6. Case 6. A Lesser Degree of Dilatation than in the Preceding Case

questionable "diverticulitis." No diverticulum was found but the appendix was removed. Since then the attacks of pain have occurred every two weeks, lasting three to four days. The vomiting has lasted only for twenty-four hours, and after this the pain has been somewhat relieved. There were never urinary or rectal symptoms. The last attack occurred seven days before admission and lasted four days, with nausea and vomiting for four hours, during the first day. Besides these symptoms the patient suffered from dull frontal headaches for the past two months, not related to meals.

Physical examination was negative except for tenderness and pain on palpation in the left kidney region. Pressure on the twelfth rib caused pain. The admission specimen of urine was pale and cloudy; reaction, acid; specific gravity, 1013; a slight trace of albumen, but no sugar. The hemoglobin was 90 and the white blood count 10,400. Cystoscopy performed on March 13 showed a normal bladder. Both ureters were catheterized and an immediate flow occurred from the right side, but none from the left. Cystoscopy repeated two days later showed a hydronephrosis on the left side. Plain plates of the kidneys with a catheter in situ on the left side did not show the outlines of the kidneys because of slight movement on the part of the patient. There was no evidence of a calculus shadow within either kidney region or along the course of the ureters. A pyelogram showed a hydronephrosis of the left kidney with marked dilatation of the pelvis and blunting of all the calyces.

Operation on March 17 found a large hydronephrosis due to an artery crossing the ureter at its junction with the pelvis and anterior to it. Accompanying this vessel there were two veins of considerable size. Examination of the hilus of the kidney failed to demonstrate any artery entering the organ in this place. The upper pole of the kidney was not exposed but it is to be surmised that there was a similar polar artery in this region also. After the kidney, together with its pelvis, had been made thoroughly movable, the ureter was cut away from the pelvis and the point of its insertion closed by interrupted stitches of fine catgut. A point on the pelvis more dependent and posterior to the vessel was then chosen and the split end of the ureter anastomosed to an incision made in this portion of the kidney pelvis. Suturing was done by interrupted stitches of fine catgut. In this instance the polar supply was evidently double, the lower artery running in front of the pelvis. Its central origin was not investigated. Convalescence was without event, and the patient reported five months later that she was entirely well.

On examination of these histories there are several points which stand out clearly. First as regards the *age*. This condition is definitely one of the young or adolescent. The large majority of cases date the onset of their trouble from sometime within the second decade.

Pain. This is usually definitely localized under the costal margin or in the back in the region of the costo-vertebral angle. It is most apt to appear in attacks varying in frequency, and with the passage of time, increasing in severity with shortening of the free periods between them. The pain does not radiate much as a rule, except possibly at the height of an attack when it may be referred somewhat along the course of the ureter. In the acute attack nausea and vomiting is common. The acute attack frequently appears to come on rather sharply reaching its maximum in the course of a few hours and then subsiding slowly leaving a heavy aching sensation in the region of the kidney which may persist for several days.

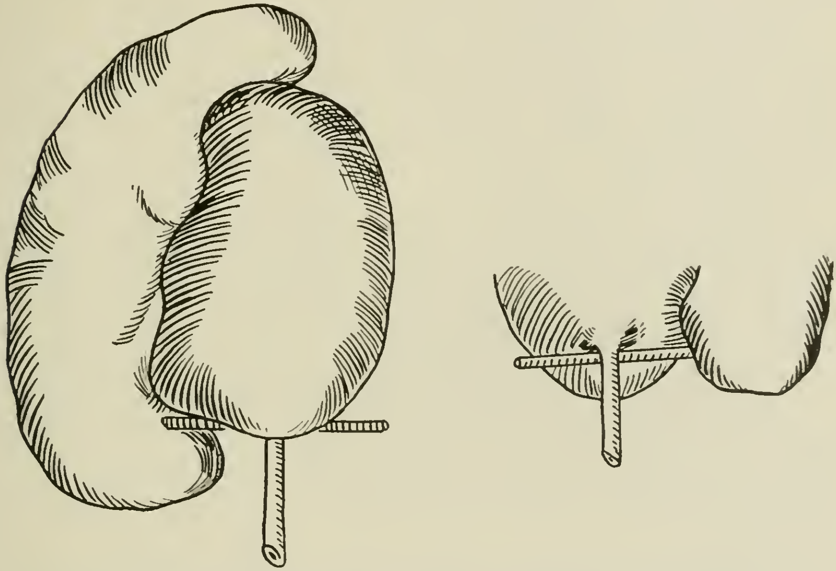

Fig. 7. Diagrammatic Sketch of Relation of Aberrant Polar Artery to Pelvis and Ureter

In the intervals between attacks some patients experience a heavy, dragging feeling, sometimes amounting to a real ache on the affected side and it is quite characteristic that certain motions of the body must be avoided, or some especial position must be taken when in bed in order to insure comfortable sleep.

Tumor. In those cases which have progressed to a point where the pelvic distention is great, there may appear a palpable tumor during the acute attack, which goes when the pain subsides. More commonly, however, neither kidney is palpable.

Palpation during an attack frequently elicits pain and tenderness over the kidney region either in front or behind, and this may persist during the free intervals to a minor degree, but there is no evidence whatever of excessive mobility of the kidney to be found either on palpation or by x-ray made in standing and lying positions.

Urination is accomplished without unusual symptoms in the majority of instances. Occasionally one finds some slight frequency during an attack. It is rare to get the spontaneously offered statement that large amounts of urine are passed after the attack. There is no ardor or other sign of inflammation.

The renal function test is usually quite normal when estimated for the combined kidney output and *examination of the urine* chemically and microscopically finds it either normal or showing only a very slight trace of albumen or an occasional white or red cell.

A normal temperature and white count is characteristic, though at the height of an attack there may be slight transient pyrexia.

The general condition of these patients is excellent as a rule, and they are in no way incapacitated except at the time of acute pain. Therefore the *general physical examination* is usually entirely normal except in respect to the points outlined above.

Special examination of the urinary tract is also normal as regards cystoscopic observation of the bladder and ureteral orifices. Catheters of the usual sizes can be passed up either ureter for a normal distance without impediment. Divided renal function gives the first suggestion of the location of the difficulty, one kidney or the other showing definite interference with normal action. Usually the flow from the hydronephrotic side will be found continuous rather than intermittent, and on investigation by pyelography the actual distension of the pelvis and calyces is made clear.

Treatment. It is obvious that the only form of treatment which will avail is operative. Three types have been employed: (1) nephrectomy; (2) ligation and section of the aberrant vessel; and (3) plastic operations on the dilated pelvis at its junction with the ureter.

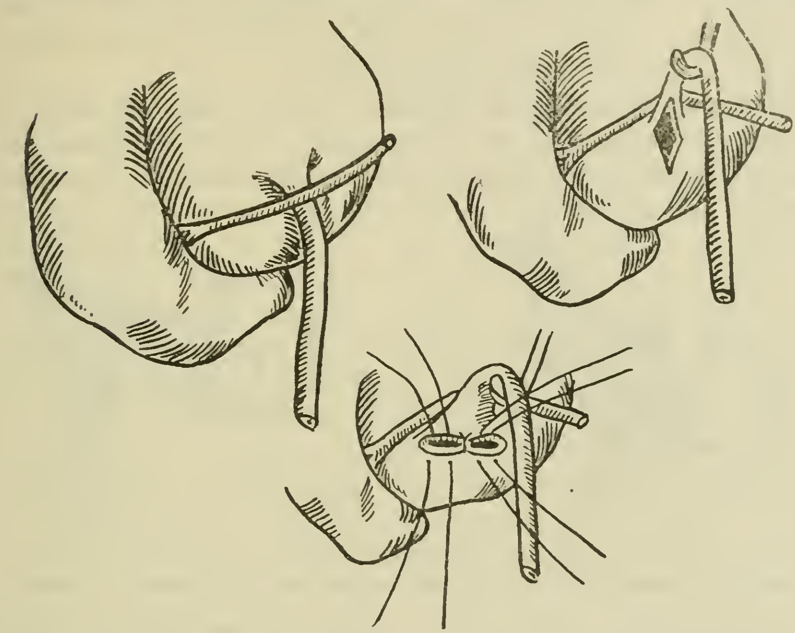

Fig. 8. One Type of Plastic Operation on the Uretero-Pelvic Junction

Drawing adapted from Kelly and Burnam, Diseases of Kidneys, Ureters and Bladder, i, 551.

Nephrectomy while definitely curative should always be reserved for those cases in which previous functional examination has shown the kidney to be of no value as a secreting organ. Considering the slowly progressive nature of this ailment it is to be hoped that a proper recognition and earlier diagnosis will make nephrectomy less and less necessary.

Ligation of the vessel has produced cure of the condition in a number of the reported cases. This is only to be justified in those instances in which observation of its size shows that it is insignificant and in which other vessels can be demonstrated to be adequate. The reason for this is that though there is a relatively good system of anastomatic channels within the kidney as viewed by the microscope, clinical experience has shown that necrosis of a portion of the parenchyma follows ligature of all but the smallest of these aberrant vessels.

The most ideal type of operation when the kidney has any functional value is that which does away with the intimate relations between the aberrant artery and the excretory passages.

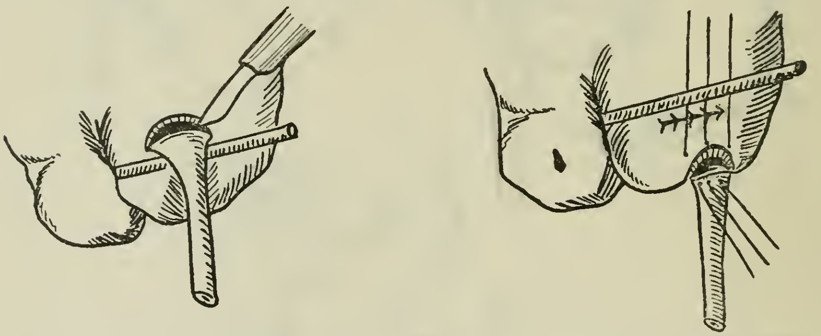

Fig. 9. Operation by Section of Ureter, Followed by the Reimplantation into a Dependent Portion of the Pelvis Away from the Aberrant Vessel

In some instances this has been successfully accomplished by a short incision from pelvis to ureter which is then sewn together in the opposite direction after the manner of the Heineke-Mickulicz pyloroplasty. This of course is partly based on the assumption that there is either a stricture or valve formation at the pelvic outlet. Such conditions, though they doubtless occur, judging from the material afforded by our cases would seem to be quite secondary to the formation of the hydronephrosis and not its cause. There was no stricture or valve to be found in any of our cases. A free section of the ureter followed by its re-implantation into the most advantageous portion of the pelvis, away from the vessel, has thus seemed to us the most ideal form of plastic operation, and this has been carried out on three of the cases with brilliant result.

ABSORPTION FROM THE URINARY TRACT[1]

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With the advance of knowledge concerning the pathology, diagnostic methods, and treatment of the diseases of the urinary tract, the absorptive powers of its various portions have assumed greater significance. The introduction of drugs into the urethra, bladder, ureters, or pelvis of the kidney, whether as opaque mediums, for roentgenologic procedures, or as therapeutic agents, are noxious in proportion to their capability to cause local irritation, to their toxicity, and to their absorbability. Through absorption, also certain parts of this system, once infected, may be the source from which secondary or metastatic infection occurs.

In this study experiments have been conducted for the purpose of determining whether certain dyes and bacteria can be absorbed from the pelvis of the kidney, the ureter, and the urethra. Dogs etherized at constant ether tension, were used in all the experiments. Their conditions were kept as nearly normal as possible by the judicious use of heat, and so forth. In some of the experiments blood pressures were recorded. All operative manipulations were carried out with the minimum of trauma and hemorrhage. The dyes used included phenolsulphonephthalein and indigocarmin; these were recovered in the urine, collected from one or both ureters, depending on the nature of the experiment. The urine was collected in white porcelain dishes. One or two drops of sodium hydroxid, 25 per cent, was placed in each dish when phenolsulphonephthalein was employed. *Bacillus prodigiosus* was the bacteria chosen, because it is easily identified, because it probably never occurs spontaneously in the sites from which cultures were taken, and because it is rarely the cause of bacterial contamination in laboratories. The bacillus was grown in dextrose broth or washed from agar slants with sterile salt solution. The suspensions of dyes and bacteria were injected with a syringe, care being used to exert only the minimal amount of pressure. A careful record was kept of the time the dye was introduced and the urine was tested repeatedly for the dye. When bacteria were used, the dogs were killed with ether at the end of from two to three hours and cultures taken from the heart's blood, the lungs, liver, spleen, inferior vena cava opposite the renal vein, right kidney cortex and medulla, and left kidney cortex and medulla. The cultures were made by planting from 2 to 5 cc. of blood and from 0.2 to 0.5 cc. of the tissue juice of the various organs into tall tubes of glucose broth. The material from the tissues was obtained by aspirating the macerated particles and juice into sterile pipettes. The inoculated tubes were allowed to stand at room temperature for from forty-eight to ninety-six hours. The positive cultures were then plated on plain agar. In many of the experiments the fluid was warmed to 35°C. before injection. The absorption from the various components of the urinary system were considered separately.

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[1] Abridgment of thesis submitted to the Faculty of the Graduate School of the University of Minnesota in partial fulfillment of the requirements for the degree of Master of Science in Surgery, March, 1922.

ABSORPTION FROM THE PELVIS OF THE KIDNEY

Treskin in 1872, concluded that urea excreted by the kidneys, may enter the blood or lymphatics from the urinary passages. Albarran in 1889, was among the first to investigate experimentally the infections of the blood stream through the kidney. He produced infection in the blood stream by introducing *Bacillus pyogenes* into the ureter. His work, however, was without previous bacteriologic control of the blood, and in many cases peritonitis occurred. He traced the organism from the bladder to foci of infection in the kidney. "From these foci the organisms go into the connective tissue and then penetrate the blood vessels, enter the circulation and lead to far off emboli." Bazy says, "On injecting a cocain solution (1:1) into the ureter of a rabbit it will ascend to the kidney and death ensue." Lewin and Goldschmidt assert definitely that absorption occurs from the kidney. Waschetko asserts that in the anatomic integrity of the kidney, the epithelium of the kidney and of the excretory ducts from the kidney is without doubt permeable. Lepine and Boulard believe that a partial resorption of sugar occurs in the tubules of the normal kidney.

Burns and Swartz do not believe that absorption takes place from the pelvis of the kidney under normal conditions. If acute pyelitis occurs, however, absorption, and the clinical phenomena of chills and fever result. These authors believe that such clinical manifestations are due to the absorption of urine and bacterial toxin, either from the blood vessels or lymphatics of the mucosa of the renal pelvis directly or from the urine and bacterial toxins retained in the uriniferous tubules. They do not suggest, however, that these clinical symptoms may be due to the passage of the bacteria through the kidney into the blood stream, thus causing bacteremia. In their later work, after the injection by the gravity or syringe method, of indigo-carmin and India ink particles into the previously ligated ureter, they found these substances in the opposite kidney, and in the liver, lungs and spleen. They conclude: "It is reasonable to suppose that if particles of ink can travel in this manner, bacteria and other foreign substances can do likewise."

Macht says that certain drugs or poisons may be absorbed through the pelvis of the kidney. Weld has shown the ease with which certain drugs may be absorbed from the renal pelvis and the untoward action of some of them. He also demonstrated that phenolsulphonephthalein and brilliant green (?) were quickly and readily absorbed when injected in small amounts (1 to 1.5 cc.) into the pelvis. Kidd has recently said that the renal pelvis is a highly sensitive absorbing surface, not only for bacterial poisons, but for chemical poisons such as cocain.

Experimental work

A dog was etherized and a low right rectus incision made. The right ureter was isolated and ligated at its juncture with the bladder. A small ureteral catheter was then placed in its upper portion and ligated there. The wound was closed. The animal was then turned on its right side and a left lumbar incision made. The left ureter was exposed at its juncture with the pelvis of the kidney. A small ureteral catheter was introduced into the pelvis and held there by a purse-string suture. Through this 1.5 cc. of phenolsulphonephthalein was injected. The catheter was then withdrawn and the purse-string suture tied. Care was taken to avoid soiling and no appreciable pressure was used during injection. The urine collected from the right ureter gave the characteristic reaction in twenty minutes for phenolsulphonephthalein which continued to be excreted for a period of two hours. The experiment was not repeated because the results were conclusive and had been previously confirmed by Weld. I have demonstrated in a previous study that bacteria may pass from the pelvis of the kidney into the blood stream, under conditions analogous to some of the states found clinically.

ABSORPTION FROM THE URETER

I was unable to find in the literature extensive data concerning this phase of the problem. Bazy believes that the ureter has little absorbing power. Lewin and Goldschmidt and Cohnheim believe that absorption occurs from the ureters. Weld, in two experiments in which 1.5 cc. of phenolsulphonephthalein were injected into the ureter, found that there was no absorption of the dye. Macht, on the other hand, has shown that certain drugs may easily be absorbed from the ureter.

Experimental work

Two series of experiments were performed. In the first a right lumbar incision was made, exposing the ureter at its juncture with the pelvis of the kidney. A ligature of fine silk was then placed around the ureter at this point, care being taken to avoid injury to its blood supply. The wound was closed, the animal was turned on its back, and a low right rectus incision made into the peritoneal cavity. The left ureter was isolated at its juncture with the bladder and a small ureteral catheter ligated in its upper portion. A ligature was placed around the lower right ureter

TABLE 1

Absorption from the ureter

EXPERIMENT	CONDITION OF URETER INJECTED	DYE USED	AMOUNT OF DYE INJECTED cc.	APPEARANCE OF DYE	APPARENT AMOUNT OF DYE	COMMENTS
62	Normal left ureter	Phenolsulphonephthalein, no dilution	1.0	In ten minutes from right ureter	Large	In this experiment the ureteral catheter was placed into ureter from the inside of bladder and the ureteral orifice closed by double purse-string suture after removal of catheter; there was some soiling in bladder
69	Normal left ureter	Phenolsulphonephthalein, no dilution	0.5	In nine minutes from right ureter	Large	One ureter was slightly distended at necropsy
78	Normal left ureter	Phenolsulphonephthalein, no dilution	0.25	Negative	Negative	The blood vessels were injured at the upper portion of ureter; slight leakage
87	Normal right ureter	Phenolsulphonephthalein, no dilution	0.25	In nine minutes from left ureter	Large	
107	Normal right ureter	Indigocarmin, no dilution	0.25	In thirty minutes from left ureter	Fair	Questionable interference with blood supply of ureter
125	Normal right ureter	Phenolsulphonephthalein, no dilution	0.25	In two minutes from left ureter	Large	
171	Normal right ureter	Phenolsulphonephthalein, no dilution	0.25	In thirty minutes from left ureter	Large	

(avoiding the blood supply), the ureter opened, and a small ureteral catheter introduced for 1 to 2 cm. into its upper portion and the ligature tightened around it, but not tied. Varying amounts of phenolsulphonephthalein or indigocarmin were then injected through the catheter. The catheter was removed and the ligature tied tightly. The operative area was well packed off to avoid soiling. The wound was closed. The urine from the left ureter was collected in the usual manner (Table 1). Absorption occurred in six of the seven experiments.

In the second series bacteria were used and a similar technic was employed, with the exception that the left ureter was not disturbed. Cultures were taken as usual (Table 2). In only one of the five experiments were the organisms recovered, that is in the spleen and vena cava.

TABLE 2

Absorption from the ureter

EXPERIMENT	AMOUNT OF FLUID CULTURE INJECTED	CONDITION OF URETER	CULTURE FOR *Bacillus prodigiosus*
	cc.		
144	0.375	Normal right ureter	Negative
149	0.25	Normal right ureter	Negative
150	0.5	Normal right ureter	Negative
161	0.33	Normal right ureter	Positive in spleen and vena cava
233	0.33	Normal right ureter	Negative

ABSORPTION FROM THE BLADDER

For many years physiologists have discussed the absorbing power of the normal bladder, certain of them believing that the normal bladder does not absorb, while others believe that it does. The majority agree that the acutely inflamed bladder absorbs to some extent. Macht has recently shown that the bladder absorbs certain drugs poorly. Shoji concludes that the epithelial layer of the bladder in the living animal is permeable to water and sodium chlorid under physiologic conditions.[2]

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[2] The literature on absorption from the bladder will be published in an article by Mann and Magoun.

From a large series of experiments previously performed, dealing with the absorption of various dyes and the *Bacillus prodigiosus* from the bladder, it was found that the dyes were absorbed to a slight extent, while there was no absorption of bacteria.

ABSORPTION FROM THE URETHRA

Claude Bernard in 1857, found that intoxication ensued when he injected curare into the urethras of dogs. Alling noted that the healthy urethra is capable of absorbing medicinal substances injected into it, Pousson and Sigalas, that absorption takes place from the prostatic urethra, Maas and Pinner that there is absorption from the normal urethra, but if the urethra is diseased, absorption may be greater or less than in the normal. Cohnheim, Phélip, Walsh and Bazy believe that there is absorption from the urethra. Macht has shown that certain drugs are easily absorbed from the urethra and Kidd that the urethra possesses a great absorbing power.

Experimental work

Male dogs under constant ether anesthesia were employed. A low right rectus incision was made, the bladder was drawn up and a double ligature placed around the urethra at its juncture with the bladder. A small urethral catheter was ligated in the upper portion of each ureter. The abdominal wound was closed. A purse-string suture was then placed around the external urethra and a no. 10 French soft rubber catheter introduced for about 1.5 cm. and the purse-string suture tightened on this. From 2 to 4 cc. of the dye was injected slowly into the urethra through the catheter with a minimal amount of pressure. The catheter was withdrawn and the purse-string suture tied. Care was taken to avoid soiling around the prepuce. The urine from both ureters was collected as usual (Table 3). In four of the five experiments the phenolsulphonephthalein or indigocarmin appeared in the urine from one or both kidneys. In two of the four positive experiments the discrepancy in the time of appearance of the dye is probably owing to the delayed secretion of urine.

TABLE 3

Absorption from the normal urethra

EXPERIMENT	CONDITION OF URETHRA	DYE USED	AMOUNT OF DYE INJECTED	APPEARANCE OF DYE	APPARENT AMOUNT OF DYE	COMMENTS
			cc.			
49	Normal	Phenolsulphonephthalein, no dilution	3	In about forty-five minutes from both ureters	Fair	
58	Normal	Phenolsulphonephthalein, no dilution	2	In both ureters in five minutes	Large amount. Quantitative estimation 2.5 per cent in two hours	Slight pressure used when injecting
59	Normal	(1) Indigocarmin, no dilution	3	Negative for one hour	Negative	Between Procedures 2 and 3, 2 cc. of fluid withdrawn from urethra by pressure
		(2) and (3) Phenolsulphonephthalein no dilution	2	Negative for one-half hour	Negative	
			4	From both ureters in thirty minutes	Large	

61	Normal	(1) Phenolsulphonephthalein no dilution	3	From both ureters in six minutes	Large amount. Quantitative estimation; 2 per cent in three hours	Fluid withdrawn from urethra by catheter and syringe between Procedures 1 and 2
		(2) Indigocarmin, no dilution	2	From both ureters in fourteen minutes	Large amount	Slight soiling of phenolsulphonephthalein about prepuce. No soiling with indigocarmin
78	Normal	Indigocarmin, no dilution	2	Negative	Negative	Phenolsulphonephthalein was placed in left ureter and there was no secretion (Table 1)

When bacteria were injected into the urethra, a similar technic was employed with the exception that the catheters were not placed in the ureters and that cultures were taken within two or three hours as in the preceding experiments (Table 4). In only one of the five experiments were the bacteria recovered and in this case they were found in the urine from the bladder.

TABLE 4

Absorption from normal urethra

EXPERIMENT	AMOUNT OF FLUID CULTURE INJECTED	CULTURE FOR *Bacillus prodigiosus*
	cc.	
125	1.5	Negative
171	3.0	Positive in bladder urine
213	4.0	Negative
221	3.0	Negative
226	4.0	Negative
239	4.0	Negative

DISCUSSION

These experiments demonstrate that the absorptive powers of the various portions of the urinary tract differ. The kidney absorbs dyes and bacteria to a marked extent. The ureter and urethra absorb the dyes readily but the bacteria less readily. The bladder, on the other hand, absorbs a very small amount of dye and no bacteria.

Absorption from the urinary tract is of importance, clinically, in several ways. The possibility that drugs introduced into the urethra, the ureter, or renal pelvis for whatever cause, may absorb and lead to dire results should always be borne in mind. It has been suggested that if the bladder is capable of absorbing to any great extent, the retention of the urine (containing the excreted dye) in the bladder for a period of two hours might lead to reabsorption of the urine and an unreliable phenolsulphonephthalein estimation. As it has been shown distinctly that the bladder has little absorbing power, this probably cannot occur. On the contrary, any lesion or deformity which would lead to retention of the dye-containing urine in the ureter or pelvis of the kidney, might result in the absorption of this urine and an apparent low phenolsulphonephthalein output. The following case is an example:

Case A359632, Mr. E. M., aged twenty-one years, came to the Clinic February 23, 1921, complaining of painless hematuria. At the onset of his illness, September 1920, hematuria was slight and intermittent; recently it had been more severe and constant. For eight years the patient had had a slight dull backache referred to the lumbar area.

Roentgenograms revealed multiple shadows in the left kidney. On cystoscopic examination the catheter encountered obstruction in the left ureter 2 cm. above the orifice. There was no return of phenolsulphonephthalein from the left kidney. Operation revealed a large hydronephrotic sac, with a capacity of about 300 to 400 cc. containing multiple round stones. Approximately one-half of the normal amount of kidney tissue remained; the ureter was not dilated.

In this case there was an indefinite form of obstruction at the ureteropelvic juncture. A large amount of renal tissue remained. The diminished output of the phenolsulphonephthalein in the presence of so large an amount of renal tissue, may be explained by, first, dilution of the dye by fluid in the renal pelvis, second, reflex inhibition of secretion caused by the presence of the stones, and third, the reabsorption of the dye from the pelvis of the kidney.

It has been suggested that in cases of pyelitis, the clinical phenomenon of chills and fever may be due to the absorption of urine and bacterial toxins. In the last few years the fact that the bacteria themselves may be absorbed from the urinary tract into the blood stream and result in a bacteremia, has received more attention. Braasch has noted that reactions following cystoscopy occurs much more often in male patients than in female. He attributes this to the absorption of bacteria throughthe prostatic urethra. Crabtree observed nine patients with hypertrophy of the prostate who were admitted to the hospital with sterile urine and then an inlying catheter was introduced. Blood cultures were taken during or soon after the chills which these patients developed. Organisms belonging to the colon group were recovered in seven of the nine cases.

Crabtree believes that infection occurred by way of the prostate from infection of the prostatic urethra from the inlying catheter; he says, "One cannot deny that a pyelonephritis might be the source of a blood infection in the cases in which I have recovered the colon bacillus from the blood. Yet in the one case in which sufficient data was obtained to allow conclusions, blood infection was apparently primary."

Panton and Tidy recovered the colon bacillus from the blood of two patients who were apparently suffering from pyelonephritis. Kidd in discussing these cases, says, "Bacteria cannot be found in the blood except during the rigor in these cases of pyelitis. Further work is needed on this subject. I feel certain that it will be proved that a rigor means in every case a temporary and cursory invasion of the blood stream with some microörganism." Braasch has found that patients occasionally develop chills and fever when a ureteral catheter is passed into the pelvis of the kidney. He assumes that in this type of case bacteria carried to the renal pelvis by the ureteral catheter may pass back through the kidney and infect the blood stream. I have taken cultures during chills in nine cases of pyelonephritis and one of epididymitis complicating prostatic hypertrophy. Organisms were recovered from the blood in six cases. In two the organism was definitely identified as the colon bacillus and one as *Bacillus pyocyaneus.* One was a Gram-negative bacillus resembling the colon bacillus. Another was a diphtheroid Gram-positive bacillus, and the last was *Staphylococcus albus.* The last two organisms were considered to be contaminations. There were four negative cultures including the one from the case of epididymitis.

No attempt has been made to study absorption under pathologic conditions, neither has the path by which absorption takes place been dealt with. In general one may assume that the absorption occurs through the blood and lymphatics the greater absorption through the former.

CONCLUSIONS

1. Certain dyes and bacteria can be absorbed from the normal kidney, ureters, and urethra.

2. A small amount of dye can be absorbed from the normal and acutely inflamed bladder.

3. Bacteria could not be recovered in the blood stream or various organs after injection into either the normal or acutely inflamed bladder.

4. In considering the relative absorbability, the kidney would seem to have the greatest absorptive power, with the urethra second and the ureter third.

5. It would appear that both experimentally and clinically, bacteria may pass from the pelvis of the kidney into the blood.

6. In certain clinical cases, the kidney, once infected, may act as a focus for a secondary bacteremia.

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TUBERCULOSIS OF THE ADENOMATOUS PROSTATE[1]

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Tuberculosis of the prostate, apart from that which is coincidental to epididymal tuberculosis, is a lesion of extreme rarity.

George Walker (1) has reviewed the literature with care and has excluded all but one or two of the reported examples of prostatic tuberculosis on the grounds of insufficient evidence. He says, "there remain still several autopsy records and possibly a few clinical reports which can be accepted, and these show that primary tuberculosis of the prostate does occur." None of the cases reviewed by Walker seem to be analogous to the one about to be decribed.

In a more recent review of the subject Koll (2) found "but 2 probable cases of primary tuberculosis of the prostate reported." His statement, with which I agree, that this "does not represent a true percentage of the primary invasion of the gland by the tubercle bacillus, but a deplorable failure on the part of surgeons to have careful histologic examinations made of their specimens" is possibly, even probably, accountable for the scarcity of such cases.

The 2 cases cited by Koll were apparently undoubted examples of tuberculosis of the prostate combined with adenoma. To these he adds 1 case of his own similar to mine in that the clinical history, physical examination and operative procedure differed in no detail from that of the ordinary adenomatous gland. The report of the pathologist alone drew attention to the rarity of the lesion. Because of the extreme infrequency of such cases and also because it is possible that frequent and more careful histologic examination of specimens may reveal other instances I wish to record the following case.

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[1] Read at the meeting of the American Association of Genito Urinary Surgeons, Washington, D. C., May, 1922.

G. A. C., railway mail clerk, aged fifty-seven years consulted me in October, 1921. There had been more or less irritability of the bladder for about a year, the symptoms being somewhat relieved by taking hexamethylenamin. In August, 1921, urination became very difficult and amounted almost to retention. There was moderate diuria (five to six), much nocturia (five to six), but no dysuria, urgency or hematuria. Retention gradually increased so that before consulting me he had been catheterized on three different occasions, about a pint of urine being removed each time. Catheterization gave a certain amount of relief each time. There had been no loss of weight or strength and no pain. There were no symptoms referable to the urinary tract other than those described.

Physical examination showed a well preserved and healthy looking man. Tongue moist and clean, chest negative, abdominal examination negative. Rectal examination showed considerable enlargement of the prostate, which did not appear to be malignant, nor was it tender, nodular or indurated. Epididymes showed a small amount of thickening throughout but patient recalled no acute lesion of these organs. Soft rubber catheter passed easily to the bladder withdrawing several ounces (residual) of hazy, acid urine with a specific gravity of 1018, no albumin or sugar, and with a moderate amount of pus in the sediment.

Suprapubic prostatectomy was done in two stages, the first operation on October 26, 1921, with novocain local anesthesia. At this time palpation of the bladder aspect of the prostate aroused the suspicion of possible malignancy as the gland felt rather more firm than is usual with adenomatous hypertrophy. The operation was completed November 1, 1921, under spinal anesthesia. During removal of the prostate it was found to be much enlarged, with areas of induration and adhesion here and there which seemed to confirm the suspicions of malignancy already alluded to.

Convalescence was uneventful in every way and the patient left the hospital with a tight wound, normal urination and no residual on November 12. A month or two later the patient lifted a heavy mail bag and soon after noticed a leakage of urine from the suprapubic scar. Examination at this time showed a pinpoint opening at the lower end of the wound, no residual and a urine which was practically clear. Rectal examination showed only the usual smooth scar which follows prostatectomy. A short session in bed with an indwelling catheter closed the sinus and there has been no further trouble.

The interest in this case lies in the report of the pathologist, Dr. H. F. Hartwell.

> There are two irregular, soft nodules, each about the size of a plum, with moist, grayish-white surfaces on section containing soft, pale yellowish areas.
>
> Microscopic examination shows the structure of adenomatous hypertrophy with extensive wandering-cell infiltration. There are large areas of necrosis surrounded by epithelioid cells.

The specimen was unfortunately lost, thus preventing further study, but being desirous of confirming this report by another opinion, I submitted the single surviving paraffin section to Dr. F. B. Mallory who kindly made the following statement.

> It [the section] shows a well marked, fairly chronic and typically tuberculous process, namely, miliary and conglomerate tubercles with giant cells and more or less extensive areas of necrosis surrounded by endothelial leucocytes with an occasional giant cell here and there. The process has invaded the lumina of the glands and ducts of the prostate in places and is extending along them. One focus of uninvolved gland tissue is of the hyperplastic type often seen in the nodules present in hypertrophied prostates, commonly but incorrectly spoken of as adenoma.

The interesting speculation now arises as to which process was primary, adenoma or tuberculosis. I incline to the view that the former lesion first appeared, for the reason that if tuberculosis was the primary offender it would have by its production of necrosis, caseation and deposition of fibrous tissue so destroyed the parenchymatous elements of the prostrate that adenoma could not have developed. There was no demonstrable tuberculous process in the lungs (x-ray of the chest might have revealed an old process) so that the origin of the process in the prostate is a question which cannot be decided. An interesting feature of the case, to which I invite special attention, is that tuberculosis of the genital tract is primarily a disease of the young adult, the frequency with which it is found rapidly decreasing at and after middle life.

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DIFFERENTIATION BETWEEN TUBERCULOUS AND NON-TUBERCULOUS INFLAMMATION OF THE EPIDIDYMIS[1]

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The analysis of case records here reported was undertaken in the hope of securing dependable points of differentiation between tuberculous epididymitis and what might be loosely termed idiopathic epididymitis, i.e., those cases of non-tuberculous inflammation which have not followed operation or urethral instrumentation, and which have occurred in patients without gonorrhea or other gross urinary infection. It was desired also to estimate the value of certain features which we have from time to time thought helpful in differential diagnosis. This matter has been of particular interest to us at Bellevue Hospital, where we are repeatedly confronted with this diagnostic problem of non-gonorrheal inflammation of the scrotal contents.

This report is based on diagnoses made by microscopic examination of tissue removed at operation, and concerns 74 cases of genital tuberculosis, 35 of simple inflammation, and 4 of syphilis. Obviously, our notes on the occurrence of these conditions relate only to cases operated upon, and do not necessarily afford a true index of the relative incidence of tuberculous and non-tuberculous cases appearing at the clinic. The records cover a period of about five years.

Owing to the hospital rule requiring diagnosis of all cases and transfer of histories to the record room very soon after discharge of patients, the probable diagnosis must frequently be entered on the histories before the pathological report has been received.

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[1] Read at the meeting of the American Association of Genito Urinary Surgeons, Washington, D. C., May, 1922.

This affords us a clue to the incorrect clinical diagnoses in some cases (an indeterminable number), but clearly not in those which had received a pathological diagnosis before the discharge of the patient. Unfortunately a pre-operative diagnosis noted on the histories was usually lacking. With this explanation in mind, it is not without interest to note that 16 of the 35 cases of simple inflammation were found recorded as tuberculosis. Four other histories contained a recorded pre-operative diagnosis of tuberculosis; and 1 case was thought to be neoplasm of the testicle. That 20 of these 35 cases of simple inflammation were classed as tuberculosis emphasizes a need of more diagnostic information. Either the clinical or the pathological diagnosis was in error. For our present purposes, we accept the accuracy of the pathological diagnosis.

But the converse error in classification was not made. Cases which were pathologically tuberculous were properly classified, with but one exception. This man had been grouped with the syphilis cases because of a 4-plus Wassermann; but material removed from a sinus (supposedly a broken-down gumma) showed histologically definite tuberculosis.

Realizing the fallability of clinical opinion, we have, as stated, considered only cases bearing a microscopic diagnosis. Moreover, the group has been further confined by including only those cases with microscopic sections available in the pathological laboratory at the present time. The specimens examined consist of testicle, epididymis and vas only, as no operations on the prostate or seminal vesicles have been done for tuberculosis on the Urological Service at Bellevue Hospital. Doctor Douglas Symmers, the Director of Laboratories of this hospital, very kindly offered to go over all this material with me. In this review of sections from over 115 patients, he differed with the original verdict in only 2 cases, rendering his opinion in each instance without knowledge of the history or of the previous report. Because of this re-study of sections, two doubtful diagnoses were changed to "tuberculosis." Doctor Symmers pointed out that while most of the specimens could be definitely diagnosed by examining enough sections, at times the pathologist could not decide between tuberculosis and syphilis, or between syphilis and simple chronic productive inflammation. Such indefinite reports were rendered in 4 cases, which were excluded from this study.

Comparing the series of tuberculous with that of simple inflammation of the epididymis—74 and 35 cases respectively—all of the patients complained of pain or swelling of the inguinal region, the scrotum or the scrotal contents. Urinary symptoms were added by 7 of the tuberculous group and 4 of the other group.

Over 25 per cent (19) of the tuberculous cases presented involvement of both epididymes on admission, while but 11 per cent (4) of the simple inflammatory cases had double epididymitis. Stating this in another way, about 83 per cent of the double epididymitis cases were tuberculous; whereas but 68 per cent of all cases considered in this report, were tuberculous. A more striking difference was seen in the fact that over 12 per cent (9) of the tuberculous cases had had a previous epididymectomy or orchidectomy, while not a single patient with non-tuberculous epididymitis had had a similar scrotal operation. This may mean that the infectious process causing simple non-tuberculous epididymitis is short-lived after epididymectomy, and hence does not involve the remaining epididymis months later as tuberculous inflammation so commonly does. This idea is further borne out by the behavior of the accompanying prostatic and vesicle infections which are yet to be considered.

A discharging sinus was present in 38 per cent (28) of the tuberculous and 6 per cent (2) of the non-tuberculous cases; the tuberculous sinuses had existed for varying periods of time up to nine years (and nearly one half for at least a month), while neither of the two simple inflammatory sinuses had been present over two weeks.

The age at onset offers no help in differential diagnosis; 40+ per cent of the tuberculous and 42+ per cent of the non-tuberculous cases were under thirty years of age. The fourth and fifth decades were represented by 36+ per cent and 12+ per cent in the tuberculous, and 27+ per cent and 21+ per cent in the simple inflammatory groups; while 12+ per cent of the tuberculous and 9+ per cent of the non-tuberculous were fifty years or over at the time of onset.

Approximately 10 per cent of each of the two groups dated the onset of trouble from some trauma.

Thirty nine per cent (29) of the tuberculous and 62 per cent (22) of the non-tuberculous cases gave a history of Neisser infection in the past. Of the former, 3 were within two years and 1 within one year of the date of admission; of the latter, 6 were within two years and 2 within one year. (In 1 of these 2, the swollen testicle antedated the gonorrhea by six months.) However, while 8 of the tuberculous cases had had previous epididymitis (7 stated to have been with gonorrhea) on the involved side, but 4 of the simple inflammatory cases gave a history of earlier involvement of the affected epididymis. Our figures are admittedly small, but it would appear that a prior gonorrheal epididymitis has no influence on the character of a subsequent non-gonorrheal inflammation of the same epididymis.

Evidences of tuberculosis elsewhere were found in the tuberculous group as follows: bones, three times; lungs, ten times; glands, twice; previous epididymectomy or orchidectomy, nine times; previous nephrectomy, twice; renal tuberculosis proved during stay in hospital, six times (from cystoscopy done on 17 patients with pus in the urine). Among the cases of simple inflammation of the epididymis, there was but one with evidence of tuberculosis, and in this one the epididymitis occurred four months after nephrectomy for proved tuberculosis. Another very instructive case (not included in either of the two groups here reported) was a man twenty-eight years old who was admitted complaining of a painful swollen testicle of one month's duration. Epididymectomy on the other side had been performed three years before. The routine history noted frequency of urination. Pus and tubercle bacilli were found in the urine, and renal tuberculosis proved by ureteral catheterization. We supposed of course that the scrotal condition was tuberculous. The patient died following nephrectomy, and at autopsy tuberculosis was found in the remaining kidney and elsewhere. But the inflammatory condition in the scrotum proved to be a non-tuberculous abscess of the testicle; the epididymis was normal. It was noted that the seminal vesicle corresponding to this affected testicle was normal, whereas the vesicle on the side of the earlier epididymectomy was sclerotic and showed no active tuberculosis.

It is of some interest to compare the duration of epididymal disease (according to history), in the two groups of cases. In 69 of the tuberculous and all (35) of the simple inflammatory groups, the time of onset was given. The duration of scrotal symptoms was less than two weeks in 20 per cent (14) of the tuberculous and 37 per cent (13) of the non-tuberculous cases. The duration was less than one month in 25 per cent (17) of the tuberculous and 48 per cent (17) of the non-tuberculous cases. In the one to three months period, the figures were 29 per cent (20) and 11 per cent (4) for the tuberculous and non-tuberculous cases respectively. In the period of three to six months, and in that of over six months, the relative percentages were nearly identical. Adding these two period, and considering all cases that had lasted six months or longer, the tuberculous group showed 46 per cent (32) while the non-tuberculous group had 40 per cent (14). Each group presented 4 cases of swelling of the epididymis of over three years standing.

TABLE 1

Findings on rectal examinations (62) of tuberculous epididymitis cases

DURATION OF EPIDIDYMAL DISEASE	NUMBER OF CASES WITH RECTAL EXAMINATION	NUMBER OF EPIDIDYMES INVOLVED	PROSTATE INVOLVED	INVOLVEMENT OF VESICLE CORRESPONDING TO DISEASED EPIDIDYMES	INVOLVEMENT OF EITHER VESICLE	INVOLVEMENT OF NEITHER VESICLE	ANY INVOLVEMENT ON RECTAL PALPATION
Under one month	16	17	11	11	12	3	13
One to three months	18	21	12	12	13	3	16
Three to six months	14	17	11	8	10	3	14
Over six months	11	16	6	8	8	3	9
Not stated	3	3	2	2	2	1	3
Totals	62	74	42	41	45	13	55

Thus far, the data relative to the genital system has concerned only the scrotal contents, the almost invariable site of the complaint. To indicate the involvement of prostate and seminal vesicles, tables of all cases having notes on rectal examination are appended. From these tables details are easily read, but the cases are not numerous enough to warrant emphasis on any but general deductions. It suffices to call attention here to the observation that early cases (under one month) of tuberculous and non-tuberculous epididymitis have about an equal extent of involvement of the prostate and vesicles. As time elapses, these organs in tuberculosis continue to give palpable evidence of disease in about the same proportion of instances as is found in the earlier cases; whereas in simple inflammation they tend gradually to become normal on palpation. Hence *marked* involvement of the prostate and seminal vesicles after epididymitis has existed over a month, is evidence in favor of tuberculosis; after six months it becomes a very strong argument for this diagnosis.

TABLE 2

Findings on rectal examinations (32) of simple inflammatory epididymitis cases

DURATION OF EPIDIDYMAL DISEASE	NUMBER OF CASES WITH RECTAL EXAMINATION	NUMBER OF EPIDIDYMES INVOLVED	PROSTATE INVOLVED	INVOLVEMENT OF VESICLE CORRESPONDING TO DISEASED EPIDIDYMES	INVOLVEMENT OF EITHER VESICLE	INVOLVEMENT OF NEITHER VESICLE	ANY INVOLVEMENT ON RECTAL PALPATION
Under one month	16	16	6	8	9	7	11
One to three months	3	4	0	1	1	2	1
Three to six months	8	9	3	4	4	4	5
Over six months	5	7	1	0	0	4	1
Totals	32	36	10	13	14	17	18

We have thought at times that various special conditions of the vas deferens as felt in the upper scrotum, offered a guide in differentiating tuberculous from other inflammations of the genital organs, but the statistical facts of the cases that have been operated upon do not bear out these particular suppositions.

A uniformly and markedly enlarged vas we thought favored a diagnosis of non-tuberculous inflammation. However, there were but 2 such found in this non-tuberculous group, and 3 in the tuberculous group. But this bit of evidence may be misleading, as all unoperated cases have been purposely omitted from consideration at this time, and the proportion of non-tuberculous cases in the group of unoperated epididymis is probably very high. An examination of a series of cases diagnosed *clinically* as non-tuberculous, but not operated upon and not used in this study, revealed 24 with notes on the vas deferens. Nine of these were slightly enlarged and 5 *much* enlarged. This side-light is suggestive, but I wish to avoid confusing information derived from cases bearing a clinical diagnosis only, with that gained from those cases diagnosed by the pathologist.

A beaded vas was regarded as indicative of tuberculosis. But while such a condition was noted in 7 tuberculous cases, it was also present in 3 non-tuberculous. Marked involvement at the lower end (near the testicle) occurred in the same proportion in the two groups. Large nodules, 2 cm. or more in diameter, were noted along the vas in 2 tuberculous cases and 1 non-tuberculous.

Some enlargement of the vas in at least a part of its accessible length was found associated with corresponding epididymitis in about 50 per cent of both tuberculous and non-tuberculous cases of less than one month's duration. But quite a striking difference in the two groups was noted in later cases. Considering those of over a month's duration, some involvement of the vas was recorded in but 27 per cent (18) of 67 tuberculous cases with notes on the vas, and in 68 per cent (15) of 22 non-tuberculous ones. But considering the total cases of over a month's duration presenting this enlargement of the vas, over half were tuberculous; hence no great help in diagnosis is derived from this observation. In the series reported, no instance was found of any enlargement of the vas deferens without involvement of the corresponding epididymis.

Bacteriological examinations were too infrequent to warrant comment.

A small but confusing group was composed of 4 cases of syphilis that had been operated upon—3 orchidectomies and 1 double epididymectomy. The specimens were histologically syphilitic. Three cases gave positive Wassermanns (probably reported after operation); the other had no blood test recorded. Two had scrotal sinuses, for one and three months respectively, suggesting tuberculosis. But all of these 4 patients had rectal examinations with normal findings. They all gave a history of a painless, gradually increasing enlargement of the testicles, beginning from five to twelve months before admission.

CONCLUSIONS

From this study, the following considerations would seem to be of value in the differentiation of tuberculous from the non-tuberculous cases of non-gonorrheal, non-luetic epididymitis:

1. Double epididymitis found on examination, slightly favors a diagnosis of tuberculosis.
2. A prior orchidectomy or epididymectomy almost invariably means tuberculosis.
3. A scrotal sinus of over a month's duration is probably tuberculous (but it may lead to a gumma).
4. Tuberculosis elsewhere in the body means genital tuberculosis in over 90 per cent of such cases.

In the diagnosis of cases presenting themselves within one month of the onset of epididymal swelling, we are dependent largely on the above general considerations.

In the diagnosis of cases of over one month's duration, we derive some help from the rectal examination. The older the lesion, the more does *definite* involvement of the prostate and vesicles point to tuberculosis; after six months, this becomes a very marked factor in favor of tuberculosis.

Finally, it must be emphasized that simple inflammatory changes of the epididymis may last as long as tuberculosis. There were four of the 35 non-tuberculous epididymitis cases who sought advice three years or more after onset of the swelling, and but four of the 74 tuberculous cases with a similarly long history.

TUNNELLED SOUNDS AND A MODIFICATION OF THE MAISONNEUVE URETHROTOME[1]

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We all, I believe, encounter at times strictures that will admit at the beginning of instrumentation nothing beyond a whalebone filiform. Under ideal conditions this may be tied in place and left for twenty-four hours, during which time the urine will trickle alongside it relieving any retention that may exist. A second, or larger, filiform may then be passed and secured. This procedure may be repeated for several days in succession until the stricture be sufficiently dilated to take a small sound or the staff of a urethrotome. As a rule, however, especially in hospital practice, this plan is not feasible and more rapid means to accomplish our end must be employed. These, at the present time, consist of the Gouley sounds and the various types of screw-tipped filiform instruments, of which the Phillips catheter and the LeFort sounds are examples. These latter, however, are objectionable on account of their relatively large calibre, their faculty of being so frequently out of order on account of the delicacy of the screw attachments and the extreme pliability of the bougie which so often results in its coiling in the urethra. The bougie of the instruments in question may engage the stricture and pass for a short distance, but by the time,—or even before—the proximal end of the bougie with its screw attachment (which has a calibre of no. 8 F.) impinges upon the stricture, further progress is impossible.

Gouley met this problem by devising in 1873 a grooved sound, the smallest of which is no. 7 F., with a tunnel $\frac{1}{8}$ inch long at its distal end which is threaded over a whalebone filiform passing through the stricture. In this procedure, however, the sound does not always ride easily and the filiform is impinged upon at such an angle that it frequntly buckles, rendering further progress impossible. Sciving and cutting of the filiform also occur with singular regularity and even complete severing or breaking of the filiform in the urethra is not unknown.

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[1] Read before the Genito Urinary Section of the New York Academy of Medicine May 17, 1922.

With the ideal of conservatism in the treatment of stricture lurking in the background and with the objections to both these types of instruments in mind, I have endeavored to devise a type better suited to our purpose. However, one finds that the principal interest in devising a new instrument, or even the modification of an old one, lies largely in the discovery that one's work has been, for the most part, antedated. Starting with the premise that certain strictures can be passed only with a whalebone filiform, and with the objections previously stated in mind, I decided that a sound of small calibre with a tunnel running its total length would be preferable to the present types of instruments. Tiemann's, a house so long and honorably associated with the manufacture of surgical instruments, assured me that to the best of their knowledge no such instrument had ever been devised. Later I found, but not to my surprise, that Sir Henry Thompson had in 1852 devised and used a fine silver probe-pointed dilator and catheter in which the tunnel ran almost the full length of the instrument and that this was modified by Fessenden Otis in 1878 so that it could be threaded for its entire length over a whalebone filiform. Otis also added a syringe attachment at its proximal end. The shaft of the Thompson dilator was no. 12 F., while that of Otis was no. 6 F. Both these instruments have apparently completely disappeared from the view of the modern urologist. Mine will undoubtedly meet with a like fate. However, it is honorable company.

In the instruments that I present this evening I have embodied what I consider the best points of those that I have described, plus the accepted sound handle that facilitates their use, the groove on the convex surface to facilitate external urethrotomy and a change in the material used from silver to steel.

They are also uniform in calibre for their entire length. At present the sounds are being made in four sizes, ranging from no. 5 F.—a smaller calibre than any preceding instrument of this type—to no. 13 F. The two smaller sizes are not grooved, owing to their small calibre.

We have then an instrument that will, I feel, pass more easily than a Gouley sound and that serves not only as a dilator but a catheter, irrigator, instillator and guide. An added advantage also lies in the fact that the operator is able to determine that the point of the instrument is within the bladder. Of course, in its use the full length whalebone filiform (25 inches) must be employed. In using them, the urethra is first irrigated and then anesthetized with a 10 per cent novocaine solution. The filiform is then passed and the no. 5 sound is threaded over it until the face of the stricture is reached. Extremely gentle but prolonged pressure will almost invariably result in its passage. At this point, novocaine is again injected, the filiform being pushed in nearly its entire length and its distal end being threaded into the syringe. After an interval sufficient to anesthetize the urethra beyond the stricture, the sound is passed into the bladder and the filiform is withdrawn. If urine appear, one can be sure

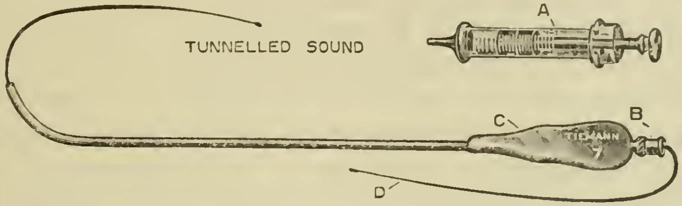

FIG. 1. *A*, Record syringe; *B*, syringe attachment; *C*, sound handle; *D*, filiform.

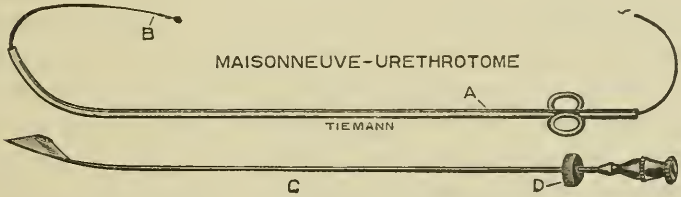

FIG. 2. *A*, Shaft; *B*, filiform; *C*, blade; *D*, rubber stop.

that the tip of the sound is within the bladder. If the bladder be empty, fluid may be injected through the sound and its return flow observed to determine this point. The filiform may now be reintroduced and the larger sounds threaded over it. If there be difficulty at the beginning in passing the filiform through the stricture, one of the larger tunnelled sounds may be passed to the face of the stricture and the filiform passed through it. By this method urethral pockets may be avoided.

I am presenting the modification of the Maisonneuve urethrotome at this time because the principle involved is identical, namely, the threading of the staff for its total length over a whalebone filiform. This is accomplished by having a tunnel running from the tip of the shaft to the groove. By this method one is enabled to do away with the comparatively large (no. 12 F.) tip of Gouley and the consequent difficulty of introduction of the staff and damage to the filiform. It also obivates the use of the screw-tipped bougies (no. 8 F. which are objectionable on the grounds already stated. If the Maisonneuve staff will not pass the stricture it may be sufficiently dilated by the passage of the smaller tunnelled sounds over the filiform. The stop placed on the shaft of the knife consists merelp of a section of a small rubber stopper and is for the purpose of limiting the excursion of the blade. This modification of the Maisonneuve I claim with no small degree of hesitancy as my own, although I have no doubt that Dr. Pedersen will presently disillusion me upon this point.

We all realize that the ratio of danger to the urethra increases inversely to the calibre of the instrument used, especially if it be a metal one. In spite of many opinions to the contrary, there is to my mind no contraindication to the use of small metal instruments in the urethra; but there is every contraindication to the use of any instrument, no matter of what calibre or texture, if it be not handled with the utmost gentleness and skill. All too often the tour de maître becomes the tour de force.

I fully realize that the instruments I present this evening and which, by the way, have been used by us on the Urological Service of Bellevue Hospital for some months past with satisfactory results, occupy a restricted and yet I cannot help but feel, an important field; and I offer them in the hope that their use may obviate, at least in some small degree, some of the formidable surgical procedures with which we are all too familiar. External urethrotomy, especially without a guide, is an operation performed all too often as a simple and timesaving solution to the surgeon, of an extremely grave problem to the patient.

May I not in closing, make a final plea for conservatism, patience and skill in all our instrumentation and may our skill be armed with gentleness rather than with fortitude.

A HISTORY OF THE DEVELOPMENT OF UROLOGY AS A SPECIALTY[1]

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The story of the evolution of urology from its meager beginnings to its present status is an intensely interesting one, and, if fully related, would comprise several volumes. It is my purpose in this brief account to detail only a few important advances in urology, chiefly of diagnostic character, which, in this modern age, have given it the rank of a specialty. No attempt will be made to embrace the history of the venereal diseases. The development of urethro-vesical, prostatic and renal surgery constitutes a long and fascinating chapter in urologic progress and will only be touched on briefly.

As long as twenty-five hundred years ago there were those who "cut for stone," a description of perineal lithotomy being given in the Ayùrveda of Sucrùta, the medical treatise of the ancient Hindus, supposed to have been written between 600 and 300 B.C. In medical literature during the many intervening centuries reference is frequently made to lithotomists. Indeed, in the Hippocratic oath will be found this sentence: "I will not cut persons laboring under the stone, but will leave this to be done by men who are practitioners of this work." One may ask, then: Is urology a new or modern specialty? It is not clear just when this branch of medicine became so complicated and refined as to require special study and training for its proper practice, but I shall not be far wrong in placing it at the beginning of the twentieth century. The work of the ancient lithotomists for the most part was that of removing vesical calculi, and they were usually ignorant of any other phase of pathology and surgery.

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[1] Read before the Osler Medical Historical Society, Mayo Clinic, Rochester, Minnesota, February 1, 1923.

In the earliest writings of a medical nature reference is made to several operations and manipulations carried out with the idea of relieving troublesome conditions in the genito-urinary tract. One of the most ancient of such records, the Papyrus Ebers, written about 1553–1550 B.C., fails to mention an operation of a urologic nature, but one will find in it the description of medical measures directed toward the relief of disturbances of the urinary function. It has been noted that the ancient Hindus performed perineal lithotomy as early as 600 B.C. Hippocrates (470–377 B.C.) advocated nephrotomy for suppuration of the kidney. He also gave considerable attention to stone in the bladder and described the process of its growth from a small nucleus. He referred to urethral abscess and cystitis; the latter was recognized by bran-like particles in the urine. Celsus, who lived at the beginning of the Christian era, mentioned urethrotomy for impacted stone, the relief of urinary retention by use of the catheter, referred to urinary obstruction of various types, including that of senility (prostatism?), and presented the symptoms of bladder stone. He described the operation of lithotomy and the postoperative care. Galen (131–210 A.D.) mentioned urinary incontinence as well as retention and described an S-shaped catheter. Aurelianus, (fourth century A.D.), wrote of various bladder diseases and described a "stone searcher."

From the fifth century on through the middle ages little was accomplished in the progress of urology. As Guiteras so well expressed it: "This period was characterized, as we know, by a decadence of surgery, when this art was relegated to the barbers, while medicine for the most part was in the hands of the monks, who disdained surgical operation."

However, as a building must be begun by dirt digging and hard labor, even before the foundation is laid, so urology passed through a period when the work was disagreeable and often disappointing. The pioneers of urology excavated in the mire and located quarries; they discovered cement and means of hoisting stones which today are to be found in our modern urologic structure. Many of us fail to appreciate the efforts of those who have gone before, and tend to regard lightly our invaluable inheritance.

During the thousand years preceding the fifteenth century practically nothing happened in the advancement of urology, or any other branch of science for that matter. Mésure, of Venice, in 1497, wrote a treatise on movable kidney. Richard Wiseman, in 1652, first performed external urethrotomy for stricture. About this time the art of printing became greatly improved. A new day was at hand when knowledge could be more widely disseminated, and it seems that science was to profit most in this awakening. The sixteenth century found Ambrose Paré (1510–1590) wielding a great influence on medicine and particularly on surgery. He did much to overthrow the old teachings of Galen; he invented a number of surgical instruments and wrote of strangury associated with enlargement of the prostate. In 1535 the "Marian operation," or median lithotomy, was originally described by Mariano Santo di Barletta. In 1556, Pierre Franco was the first to perform suprapubic cystotomy. He was a Huguenot driven into Switzerland by the Waldensian massacres.

During this period the lithotomists were thriving and were regarded with disdain by the medical profession. The town of Perugia, in Norcia (Italy), was famous for its lithotomists and whole generations devoted their time to this work, being called to various parts of Europe to operate. From Italian lithotomists the Colots of France learned the secret; first, Germain Colot, who performed a lithotomy on Louis XVI after having first demonstrated to His Majesty the operation on a criminal. The successors of Colot performed lithotomies for nearly three hundred years, until the secret was finally given to the world in 1727 by François Colot, the last of the family.

Frère Jacques, a monk referred to as "a bungling experimenter," became well acquainted with anatomy, and in 1697, introduced the lateral operation for stone; this operation was based on the finest anatomic principles. He became a wandering lithotomist and is said to have "cut for stone" more than five thousand times, but was finally exiled in disgrace from Paris because most of his patients died.

William Cheselden (1688–1752) modified the technic of Frère Jacques' lithotomy, and is said to have been able to perform his operation in fifty-four seconds. This brilliant English surgeon undoubtedly exerted a great influence on John Hunter, who was one of his students. Concerning the urologic work of Hunter, Hugh Young remarks:

> It is very evident, from a study of the clinical works of Hunter, that his private practice was largely genito-urinary in character. It was his practice to admit young men into his home for a period of years as private students of surgery, and it is not surprising to find that of these men who afterward became famous, and caused English surgery rapidly to eclipse the rest of the world, the majority were particularly interested in genito-urinary surgery. I need only refer to John Abernethy's celebrated treatise on syphilis, Sir Astley Cooper's classic on the testicle, Sir Everard Home's two volumes on the hypertrophied prostate gland, and James Wilson's anatomic researches on the external urethral sphincter.

Hunter accidentally inoculated himself with syphilis but delayed treatment in order to observe more closely the course of the disease. His famous collection of pathologic specimens contains many renal and vesical calculi, renal and prostatic tumors, and other evidences of his interest in genito-urinary affections.

As we approach the dawn of modern medicine we find many, instead of a few, diligent searchers after the truth. Schools for the investigation of problems and the teaching of the art of healing were being established and methods of diagnosing and treating diseases were undergoing constant improvement. The older ideas and theories, often mystic and absurd, were being disproved and overthrown by the efforts of such notable figures as Paré, Hunter, Selveter, and Harvey. Experimentation and observation were taking the place of blind allegiance to the teachings of Galen which had shackled the spirit of progress for ten centuries.

THE LITHOTRITE

Sanctorius, in 1625, constructed a crude, three-bladed forceps (fig. 1) with which he attempted to withdraw stones from the bladder by way of the urethra, without necessarily crushing them. The instrument was introduced into the distended bladder, the stylet was then withdrawn which released the blades, allowing them to spring apart, at the same time permitting the fluid in the bladder to be expelled through the instrument. The contracting bladder forced the stone into the open blades; being thus impinged between them, the calculus was withdrawn with the instrument. Obviously only small stones were amenable to this method of removal, and the use of such an instrument could not have been much less painful than the operation of lithotomy as it was then performed. The successful use of this stone remover must have been rare indeed.

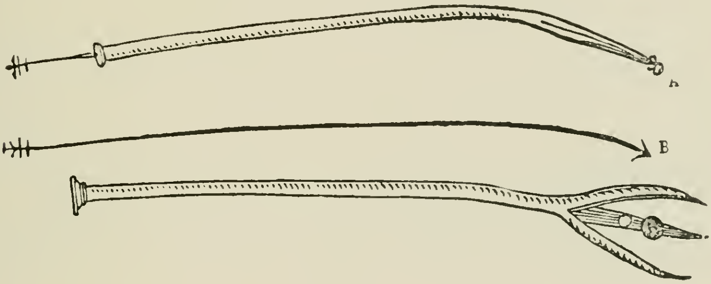

Fig. 1. Sanctorius' Stone Forceps (After Desnos; 1625)

Early in the nineteenth century much attention was directed toward the discovery of a method of removing bladder stones which would render unnecessary the terrible ordeal of lithotomy. Most such attempts were based on the principle of chemical dissolution. Acids, alkalis and various kinds of waters were tried. Whystt injected lime water; Petit used soda bicarbonate; Fourcroy advocated potassium hydrate for uric acid stones and hydrochloric acid for those composed of phosphates. Brodie used several kinds of mineral acids and, finally, Spallanzoni injected gastric juice into the bladder, hoping that this would prove to be the long sought solvent. Working along these lines, in 1818, Jean Civiale, a French physician, experienced much difficulty in judging the chemistry of stones in vivo and conceived the idea of first obtaining for analysis a chip of the calculus, following which a more intelligent effort at chemical dissolution could be made. He constructed his "trilabe" (Fig. 2), which was patterned somewhat after the stone forceps of Sanctorius. Its use was preceded by dilating the urethra by means of an inflatable sound, made of a segment of the bowel of a cat. The trilabe had three prongs which extended into its barrel; by rotation of the instrument the stone was caught between the prongs. Thereupon the withdrawal of the stylet, which was securely fastened to the prongs, was supposed to crush the stone, thus permitting a fragment to be recovered for chemical analysis. The nature of the stone being determined, this ingenious Frenchman devised a second instrument, the use of which made possible the dissolution of the stone. This was composed of a tubular sound which held at its vesical end a bag made of gold beaters skin (fig. 3). This bag was divided into two parts, one of which formed a sort of lid for the other and sealed it when the two were brought together inside of the bladder. Civiale's idea was to introduce into the bladder the

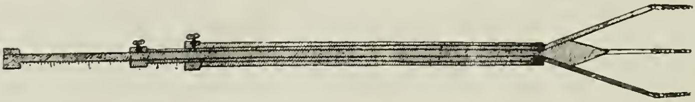

Fig. 2. Trilabe; Civiale's First Model (After Desnos; 1818)

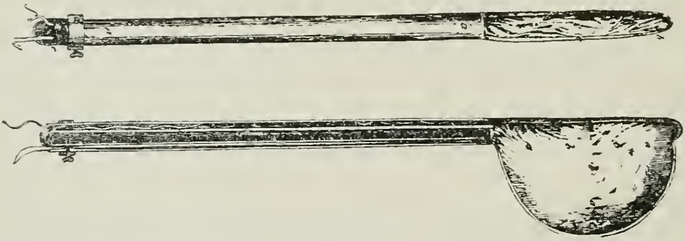

Fig. 3. Bag for Dissolution of Stone (After Desnos; 1818)

bag-carrying sound and scoop the stone or fragments into it, then pass the second, or bag-closing instrument. Now having the stone enclosed in this leather pouch, concentrated acid or alkali, depending on the result of the previous analysis, was injected through the sound, thereby dissolving the calculi. It is said this complicated instrument was never used on a living person. Fortunate it was for them "who laboured under the stone" at that remote day. However, this led to better things. Civiale at once recognized the possibility of dispensing entirely with the chemical side of the procedure, and soon produced an instrument with which the stone was grasped firmly and reduced to fragments by a drill which was operated by a tightly drawn bow ("archet") drawn swiftly over a pulley (fig. 4). This constituted the first lithotrite, which was favorably reported on by a commission appointed by the Society of the Faculty of Medicine of Paris in 1824. Their report read: "The operation is alike glorious for French surgery, memorable for its discoverer and comforting to humanity; and M. Civiale, who is well merited by his noble profession, has acquired the claim to the esteem and good will of the Academy of Medicine. . . . . "

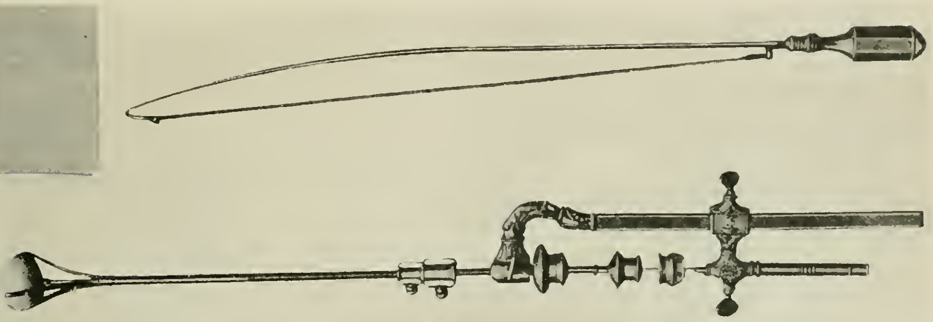

Fig. 4. Civiale's Lithotrite (After Desnos; 1824)

Civiale's lithotrite received various modifications, notably those of LeRoy d'Etoille, Meyrieux, Rigal de Gaillac, Jacobson, and Heurteloup who, in 1832 produced an instrument, the jaws of which are not unlike those of the modern lithotrite. In 1844 Carnay, of France, produced the first device for aspirating the fragments, but unfortunately this was too clumsy to be practical and was unfavorably received by the Academy. The chief objection to lithotrity, as it was then practiced, was the repeated introductions of the instrument required in clearing the bladder of fragments. This naturally rendered the operation dangerous and resulted in much work being done toward correcting this objectionable feature. Guyon, of France, Thompson, of England, and Bigelow, of America, were leaders in this work. The latter, who had studied under Louis, of Paris, and Paget, of London, provided the greatest improvement, and in 1878 rendered possible the crushing of a stone and the removal of the fragments, all at one sitting and with but one introduction of the instrument. He invented a special aspirating device which was practical and efficient and is still in use, being marketed under the name of Bigelow's evacuator. Thus, lithotrity became litholapaxy, and the operation was subsequently referred to by many as Bigelow's operation.

In Germany and Austria great strides were being made in urologic progress. To quote Bransford Lewis:

> Ultzmann studied and elucidated the subject of neuroses of the urinary organs; Dittel wrote and operated well on surgical affections of the genito-urinary organs; Gruenfeld materially advanced the position of urethroscopy; Oberlaender promoted urethral pathology and therapy and made valuable contributions to our literature; Casper, in addition to his cystoscopic work, studied the functioning power of the kidneys in relation to contemplated surgical measures; Gustav Simon first performed nephrectomy; Hahn demonstrated the feasibility and value of nephrorrhaphy; Israel introduced a formidable array of renal operations, recounted in his elaborate treatise on that subject; Freudenburg popularized the Bottini operation; von Zeissl, Kollmann, Finger, Wossidlo, Frank and Lewin were others whose names must not be omitted; if we admire the accomplishments of these and many others that might be mentioned, how shall I adequately express the esteem in which the father of modern cystoscopy, Max Nitze, is held?

THE CYSTOSCOPE

The evolution of the cystoscope began with endoscopy which was first attempted by Bozzini, of Frankfort who, in 1806, described his "Lichtleiter." This was composed of a small funnel-shaped speculum, at the bladder end of which was placed a metallic elastic spiral, with which the mucosa of the bladder was manipulated and different fields were brought into view. Light was reflected through the tube from a shaded lamp. The instrument was not received favorably by the medical faculty of Vienna, the objections mentioned being: pain of introduction, too limited field of inspection and insufficient illumination. It was applicable to the bladders of females, only, the examination of the bladders of males being considered impossible.

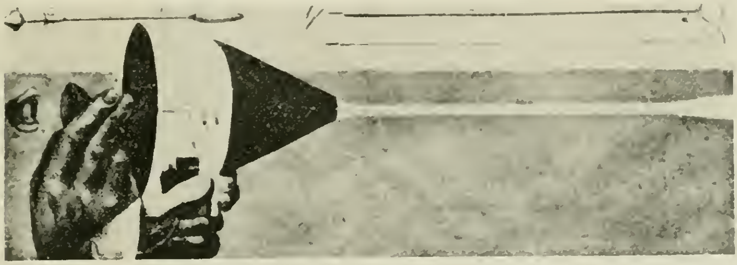

FIG. 5. SÉGELAS' URETHROCYSTIC SPECULUM (AFTER DESNOS; 1826)

As has always been the case with new and original ideas, this one was seized by numerous investigators, but nothing noteworthy was produced until 1826 when Ségalas brought out his "urethrocystic speculum" (fig. 5). This consisted of a long, silver tube, polished on the interior and having at its external end a conical mirror. An eye piece was made of a short silver tube, blackened on the interior and passed through the center of a circular mirror. Two small candles, placed between the circular and conical mirrors, formed the source of illumination. By this arrangement the light was first caught on the conical mirror which reflected it onto the circular mirror which, in turn, reflected it into the urethra and bladder. As might be expected the illumination was so dim that the instrument was of little practical value. John Fisher, of Boston, one year later described a complicated endoscope on which he had worked three years. Certain authorities endeavor to give his instrument priority over that of Ségalas.

Although various models were produced and many improvements suggested, notably by Avery, of London, Cazenave of Paris, Gessler, Malherbe and Espezel, nothing of importance occurred in the progress of endoscopy until Désormeaux, in 1853, described the first practical endoscope and presented it to the Academy of Medicine at Paris. His instrument contained a lamp which burned alcohol and turpentine, the light of which was reflected by a system of mirrors (fig. 6). By its use he diagnosed and described forms of urethritis, performed internal urethrotomy under guidance of the eye, and is said to have been the first to destroy a papilloma of the urethra, a histologic section of which is beautifully portrayed in colors in Desnos' Encyclopédie français d'Urologie.

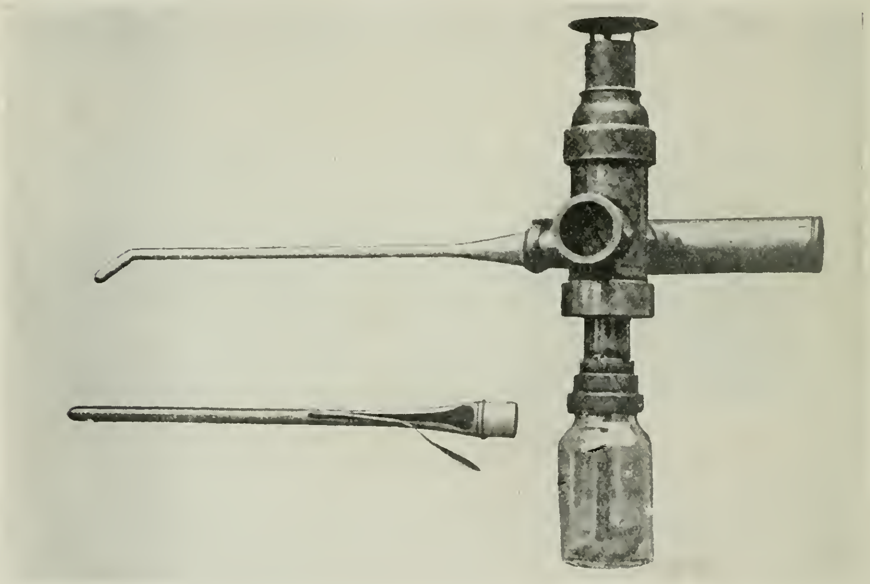

Fig. 6. Désormeaux' Original Endoscope (After Desnos; 1853)

Furstenheim popularized the endoscope in Germany and in 1865 Cruise, of Dublin, improved the endoscope of Désormeaux by utilizing the edge of the flat flame of an ordinary petroleum lamp, in which he burned a combination of camphor and kerosene, which produced a more luminous flame. He also modified the instrument so that the anterior wall of the bladder could be seen, and a short time later a side window with a mirror was so placed that the posterior urethra and prostate were bought into the range of the instrument. At best, however, this was a cumbersome affair; the problem of illumination was yet to be solved.

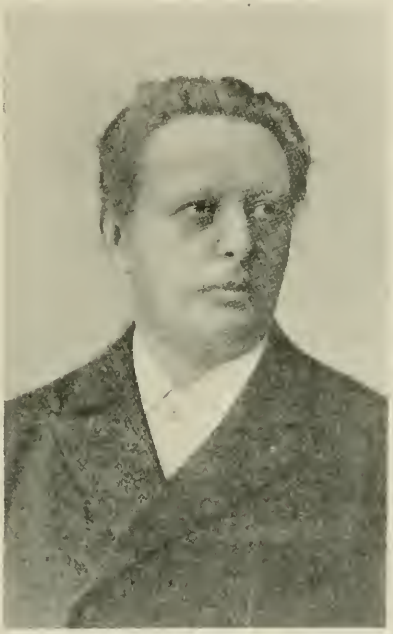

FIG. 7. MAX NITZE (AFTER DESNOS; 1848–1907)

Modification followed modification, but it remained for Max Nitze (fig. 7), in 1876, to produce an instrument which all but overcame the obstacle of poor lighting. Bruck, in 1861, a dentist of Breslau, had advocated a platinum loop, kept at white heat by a galvanic current, as an aid in inspecting the mouth. He constructed such an instrument which he called the "stomatoscope." He further suggested this means of illumination for the rectum and bladder, but his "diaphanoscope," designed for this purpose, was tried out in a Vienna Hospital and discarded as impractical. The platinum loop gave off a terrific heat from which the cavity under examination had to be protected. This difficulty was partially overcome by a system of water-cooling. Nitze adopted the use of the platinum loop and improvised a water-cooling system, both of which were utilized in his original instrument first used in 1876, fifteen years after Bruck's inventions. Harry Fenwick gave a detailed description of this cystoscope and enumerated its failings as follows:

> (*a*) The complicated water-cooling apparatus; (*b*) the sharply oval shape of the five-tube catheter; (*c*) the quill piece being insufficient to protect the platinum loop from the water in the bladder; (*d*) the nontransparency of the quill; (*e*) the fact that the quill was apt to get burned by the heat just at that spot where translucency was needed; (*f*) the window of the straight tube not being closed, the lenses of the telescope readily got soiled by the water in the bladder and impeded a clear view.

In spite of these many drawbacks, this was the Nitze cystoscope which was destined to be the greatest single stimulus urology has received, and a creation which made a place for the name of its inventor among the immortals.

Nitze demonstrated his instrument at a meeting of medical men in October, 1877, using it in a dead bladder. Concerning this demonstration it is said that "certain calculi which had been placed in the viscus for demonstration purposes were not vesical calculi, but gall-stones."

When Désormeaux's endoscope was introduced twenty-five years before, the era of aseptic surgery had not dawned. For that reason pathologic conditions of the bladder, neoplasms for instance, were regarded more with the interest of curiosity than with any idea of surgical relief. But Nitze's cystoscope came in the Listerian period and it opened up an entirely new field which was immediately utilized by the more progressive surgeons the world over.

Nitze entrusted his cystoscope to Leiter, a lens maker of Vienna, who spent ten months in improving it mechanically and optically. Nitze gratefully acknowledged these improvements and it became known as the Nitze-Leiter cystoscope. The water-cooling system and platinum loop were causes of much dissatisfaction as the services of an expert mechanician were required to keep the instrument in order. The loop would frequently fuse in spite of rheostat regulation of the current; it is said a distinguished German specialist had his cystoscope sent in for repairs once a week for two years. The genius of Edison made possible the removal of these objections by the invention of the incandescent electric lamp which was patented in 1879. In 1883 Newman, of Glasgow, devised an electric endoscope for use in the female bladder, and in 1885 Mayo-Robson succeeded in diagnosing a carcinoma of the bladder in a female by dilating the urethra and introducing a small Swan electric lamp. However, it was not until 1887, eight years after Edison's discovery, that a cystoscope was produced which was provided with an incandescent electric bulb. Two such instruments appeared simultaneously, one made by Hartwig, of Berlin, after Nitze's design, and the other a product of Leiter. It is difficult to understand this long delay in the application of Edison's lamp to cystoscopy, especially when one considers the large number of men seeking to improve and simplify this instrument, the mission of which was to abolish the guess work of urologic diagnosis and veritably bring to the surface those organs which had always remained hidden and inaccessible to investigation. Numerous minor improvements were made from time to time, but the next milestone in the progress of the cystoscope was a modification of Albarran's who, in 1897, added a leverage device with which catheters were easily directed toward the orifices, rendering ureteral catheterization much less difficult. This accomplishment almost brought the kidneys within range of the human eye and renal surgery was thereby given a great impetus.

Since then numerous models of cystoscopes have appeared until today two standard types are available. The Brown-Buerger cystoscope represents about the best of indirect or lens instruments, and the Braasch cystoscope, the simplest and most practical instrument on the market, is of the direct variety. Each type has its advantages and place in the armamentarium of the modern urologist. The lens instrument "gives a field of greater circumference; permits a clearer view of the anterior wall of the bladder in the male, and offers a more detailed and magnified view of the bladder mucosa." It is the more widely used instrument today, probably because it follows closely the pattern of the original cystoscopes of Nitze and Leiter. On the other hand, the direct cystoscope of the Braasch type is a comparatively recent instrument and its use has not become so generalized. It was first described in 1912 as a combined urethrocystoscope. Braasch pointed out its advantages in the following terms: (1) its simpler mechanism, (2) a clearer view of the field in case of hemorrhage, (3) the field is natural, requiring no interpretation, and (4) use as urethroscope as well." In using this cystoscope one finds that catheterization of the ureters is comparatively simple, is rapidly accomplished, and that ureteral obstructions are more readily detected.

The importance of ureteral catheterization to urologic diagnosis and intelligent therapy cannot be over-estimated. Pilcher asserts that Gustav Simon, Professor of Surgery, University of Heidelberg, previous to 1871, "had made a practice of dilating the female urethra with his forefinger and carrying the forefinger into the bladder, and by it had guided a catheter into many a ureter." Young, referring to this procedure, credits Simon with being the first to catheterize the ureters. Guiteras credits Iverson (1888) for "the first attempt at obtaining a clue as to the state of each kidney by catheterizing the ureters." Iverson, Guyon (1891) and others made abdominal incisions and opened the bladder in order to accomplish the study of the urine of each kidney separately. Pawlick (1886) was able to catheterize the ureters by placing the woman in the genupectoral position, depressing the posterior vaginal wall with a speculum in such a manner that a catheter was guided into the ureter by palpation and by using certain vaginal folds as guides. In December, 1888, Brenner introduced the first catheterizing cystoscope which consisted of a simple direct Nitze cystoscope to which he added a small tube to carry the ureter catheter. With this instrument he succeeded in catheterizing the ureter in one female case but failed in males. James Brown of the Johns Hopkins Hospital, using the same instrument supplied with a special curved stylet succeeded in catheterizing the ureters in a man on June 9, 1893—the first time this had ever been accomplished in the male. In one of Dr. Brown's cases he diagnosed pyonephrosis and Dr. Halsted carried out nephrectomy—the first kidney operation in the male based on cystoscopic diagnosis. Kelly (1894) introduced his method, which was a modification of the catheterizing speculums used by Gruenfeld and Newman (1880-1886), and was based on his discovery that with the hips elevated, on introducing an endoscope, the female bladder would fill with air, thus affording a good view of the ureteral orifices, which he succeeded in catheterizing under visual inspection in the Fall of 1893, several months after James Brown's epoch-making catheterization of the male ureter. The cystoscope was evidently not used for this purpose until the appearance of Brenner's instrument in 1892; this was of the direct variety and a very good instrument. Nitze (1895), Casper (1895), and finally Albarran (1897) perfected the catheterizing cystoscope.

Thus we have seen that an improved method of diagnosis, first suggested in 1806, during more than one hundred years of its evolution required the efforts and ingenuity of some of the most brilliant minds of the profession and the combined resources of surgeons, dentists, chemists, opticians, electricians, silversmiths, metallurgists, glass workers, and the wizard Edison, whom I shall not attempt to classify as he is more than an inventor.

I have related in more or less detail the history of the development of the lithotrite and cystoscope. Following the perfection of these, many valuable urologic instruments appeared from time to time. By their use the following procedures became possible; intravesical surgery, excision of the median bar prostatic obstruction or "punch" operation, the visible crushing of stones, cystoscopic rongeur work, intravesical fulguration and cauterization, radium application and implantation, and intravesical photography.

More detailed studies of the kidney having been made possible, methods were relentlessly sought by means of which more exact diagnoses of renal maladies could be effected. The two outstanding advances along this line were the discoveries of pyelography and a satisfactory renal functional test.

PYELOGRAPHY

In an excellent paper recently read before this Society by my colleague, Heacock, we were told of the discovery and development of the roentgen ray. In urology, particularly, the employment of the roentgen ray has afforded a tremendous advance. Tuffier, in 1897, was the first to suggest the use of an opaque catheter and the roentgen ray. Others quickly utilized the idea and offered improvements in the shadow-casting catheter, but it was not until 1904 that a liquid medium was used, when Klose suggested the injection of an emulsion of bismuth into the ureter and kidney pelvis. This proved unsatisfactory, but in 1906 Voelcker and von Lichtenberg advocated the use of colloidal silver as an opaque medium and these investigators were able to produce some highly satisfactory pyelograms. They made the discovery by using this medium in an attempt to outline a bladder in a cystogram and noted in the plate that the medium had entered one ureter and pelvis, both of which were clearly outlined. Severe renal damage occasionally followed the use of this medium, and in 1915 Burns reported good results from thorium nitrate. In 1918 Cameron advocated a solution of sodium iodid which has proved to be the least toxic of any of the opaque mediums, but is by no means an ideal medium. In the same year Weld introduced sodium bromid, which has also been widely used. Pyelography gained favor slowly, but little being accomplished during the three or four years following its introduction. However, its employment was taken up by Fenwick, in England, and Keyes in this country, who suggested improvements in the medium used and technic of injection. Braasch became interested in pyelography soon after its introduction in America, and in several papers published between 1910 and 1913 called to the attention of the profession its great value in the diagnosis of renal diseases. His monograph, "Pyelography," published in 1915, is the most thorough exposition of the subject yet published. By the employment of this means of diagnosis, abnormalities in the size and contour of the renal pelvis are detected and often the underlying cause is made apparent; the size of renal and ureteral calculi and their exact position are determinable, rendering their surgical removal more feasible; renal neoplasms are demonstrable long before they can be palpated; anomalies of the kidney and ureter are readily detected; hydronephrosis, tuberculosis and pyogenic infections have their pyelographic characteristics, and the differential diagnosis of renal pathology in general is much more easily accomplished.

PHENOLSULPHONEPHTHALEIN TEST

Not yet, however, had urologic diagnosis attained perfection. For many years a means had been sought by which renal function and especially the function of the individual kidney could be quickly and accurately estimated. Many such tests had been advocated, among the most important of which may be mentioned cryoscopy, introduced by Dreser in 1892; phloridzin, which was discovered by von Mering in 1885 and first used as a functional test by Klemperer in 1896; methylene blue, introduced in 1897 by Achard and Castaigne; rosaniline, introduced by Lepine in 1898; indigo-carmine, first used in 1903 by Voelcker and Joseph; and the electrical conductivity of the urine, first studied by Dawson Turner in 1907. All of these tests proved fallacious in some degree, and only one of them, indigo-carmine, is used today to an appreciable extent.

In 1910 Rowntree and Geraghty discovered a test which is all but ideal. Abel and Rowntree, in 1909, in searching for a purgative which could be administered hypodermatically, investigated the phthaleins and some of their derivatives. In the course of their experiments they observed that phenolsulphonephthalein was rapidly and almost entirely eliminated by the kidneys; furthermore, that it was non-toxic and almost devoid of any action on the organism other than being a slight diuretic. This drug was first described and used by Remsen and furnished by him for these experiments. Rowntree, assisted by Geraghty, followed up the observation which had been made on the elimination of the drug, and in their monumental work, published in 1910, described the phenolsulphonephthalein test with which we are all familiar. It provides a simple and efficient means by which the renal function can be reliably estimated by any physician, without the necessity of an elaborate laboratory or the services of a chemist. Used in conjunctions with the cystoscope, phenolsulphonephthalein indicates within a few minutes after its injection the amount of work being done by a kidney suspected of being diseased, and also whether the opposite kidney is alone capable of maintaining life. What more can be asked of a renal functional test?

CONCLUSION

In relating the history of the development of urology as a specialty, I have purposely omitted the inclusion of some of the great epoch making discoveries which had a tremendous effect, not alone on urology, but on the progress of medicine and surgery as a whole. I refer particularly to the discoveries of anesthesia, pathogenic bacteria, roentgen rays, and the principles of asepsis and antisepsis. Urology must be considered a specialty chiefly because of its modern diagnostic refinements and these I have endeavored to bring before you in their historical setting.

Prior to the twentieth century we have seen that urologists were usually surgeons, first and last, and in older times they were occasionally barbers and monks, but with the beginning of the present century we have seen that the successful urologist must needs have spent a prolonged period in preparation, in acquainting himself, first, with diseases in general and their relation to the genito-urinary tract; in developing his acquaintance with the cystoscope and ureteral catheter; in familiarizing himself with the means of obtaining satisfactory roentgenograms and pyeloureterograms, together with their correct interpretation; in schooling himself in those procedures in physiologic chemistry which have proved of so much value; and last, but by no means least, in learning the modern methods of urinalysis and the determination of renal function, all of which are directed toward the common desideratum of diagnostic precision. Having mastered these, he must equip himself for the carrying out of rational therapeutic measures, whether they be medical, or intravesical operative, or major surgical. Urology has in truth developed into a specialty and this has transpired within the memory of most of us present.

We have followed the building of our urologic structure from the breaking of ground, the laying of the foundation and corner stones, all of which was a long and laborious process which engaged the time and attention of many workers. The superstructure is now well up in the atmosphere of understanding and the sunlight of science. What a contrast to the environment of those who labored at its beginning in the heavy air of dogma and ignorance and the darkness of mysticism and superstition. Who dares to say that this construction is yet completed? Perhaps the roof has been laid, but there is much work to be done on the interior which will require the undivided time of many generations of superior artisans, and the processes of repair and modernizing will undoubtedly go on forever.

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DIAGNOSIS AND SURGICAL TREATMENT OF MALIGNANT TUMORS OF THE KIDNEY

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The early diagnosis of malignant tumors of the kidney is sometimes difficult but upon its accomplishment depends the possibility of permanent recovery. Because of this fact, the presence of even one of the classical symptoms of this condition should stimulate the urologist to make a careful and complete examination of the genito-urinary tract. This applies especially to hematuria which is usually the first symptom to appear. One should not be lulled into a sense of false security by its temporary absence or its disappearance following rest in bed. In addition to hematuria, pain and a palpable tumor are generally recognized as the three cardinal symptoms of malignant tumors of the kidney. To these a fourth should be added—characteristic deformity of the renal pelvis—revealed by pyelography. It is only within the last few years that this procedure has been accorded the recognition it deserves as an aid to the diagnosis of renal growths. In a review of 413 cases reported in the literature, I found that only 44 per cent presented hematuria, pain and enlargement of the kidney at the time of examination. On the other hand, pyelography revealed a deformity of the kidney pelvis or calices in almost every instance in which it was used. Blood in the urine is quite commonly found with renal calculi, tuberculosis and nephritis and it is sometimes seen in the presence of extra-renal tumors, appendicitis, etc. Braasch states that microscopic blood was found in the urine of 6 of 50 patients suffering from abdominal growths simulating kidney tumors on palpation but not involving this organ. Pain is a symptom of almost every pathological condition of the kidney, while enlargement of the kidney is often due to hydronephrosis, pyonephrosis, tuberculosis, cystic conditions and nephritis. Deformities revealed in the pyelogram, such as narrowing or displacement of the pelvis, with or without narrowing and elongation of the calices, however, are almost always characteristic of renal tumor. Enlargement of the pelvis is sometimes seen in carcinoma and is due to necrosis of the tumor or to an associated hydronephrosis. Ordinary radiography should of course precede pyelography, as stone shadows are usually more readily detected in the uninjected picture.[1] Visualization of the gastro-intestinal tract by air inflation or by barium meals or enemata, is often of great assistance in determining the location of an abdominal mass. Other aids to diagnosis are the occasional presence of neoplastic cells in the urine and the profuse bleeding which sometimes follows the traumatism caused by an ureteral catheter. In a series of 215 cases of hypernephroma, 86 of carcinoma and 47 of tumors of the renal pelvis in which my own cases were included, a tumor mass was present in 85 per cent, a deformity of the renal pelvis in 84 per cent, blood in the urine in 44 per cent and pain in 44 per cent.

DIFFERENTIAL DIAGNOSIS

The differential diagnosis of the various histological types of malignant tumors of the kidney is at times impossible but a careful study of the symptoms together with the cystoscopic and radiographic findings will make this feasable in many instances.

The following facts are of diagnostic significance:

Hypernephroma

1. 80 per cent of the malignant tumors of the kidney are hypernephromata.
2. Repeated hemorrhages, pain and a palpable tumor which

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[1] Occasionally, however, calculi are more easily seen because of the opaque coating formed by the injected solution.

increases rapidly in size are strongly suggestive of this type of growth.

3. With hypernephroma, a palpable tumor is present in 85 per cent, a deformity of the renal pelvis in 84 per cent, hematuria and pain in 43 per cent, respectively.

4. Pain is most marked with hypernephroma because of the pressure due to the large size of the growth.

5. Hypernephroma is more common in patients over thirty years of age.

6. Calculi are less frequently associated with hypernephroma and tumor of the renal pelvis than with carcinoma.

7. In hypernephroma a narrowing of the pelvis is usually found.

8. Varicocele due to blocking of the renal vein and edema of the lower extremities due to obstruction of the ascending vena cava are sometimes seen with hypernephroma.

9. Dilatation of the veins of the bladder is not uncommon.

10. The kidney function is decreased in many instances and not infrequently absent.

11. There are often long intervals between the attacks of bleeding.

12. Cachexia appears late.

Carcinoma

1. About 2 per cent of the malignant tumors of the kidney are carcinoma.

2. A palpable tumor is only found in about 18 per cent of these cases as death from metastases usually occurs before the tumor has attained much size.

3. Deformity of the renal pelvis is seldom absent and was observed in almost every reported case in which pyelography was used. Hematuria was present in 56 per cent and pain in 38 per cent.

4. Although a frequent symptom, hematuria is less pronounced than in hypernephroma and papillary epithelioma.

5. If the carcinoma involves the pelvis, dilatation of the latter due to necrosis is not infrequently seen in the pyelogram.

6. Carcinoma usually occurs in patients over forty years of age.

7. Calculi are frequently associated with carcinoma, occurring in 66 per cent of the cases.

8. Cachexia appears early.

Papillary epithelioma of the renal pelvis

1. Hematuria is usually present at some time, being intermittant in character. It occurred in 97 per cent of the above series of cases.

2. Pain is found in approximately 50 per cent, a palpable tumor in about 30 per cent of these cases.

3. Pyelography reveals deformity of the pelvic outline in almost every case.

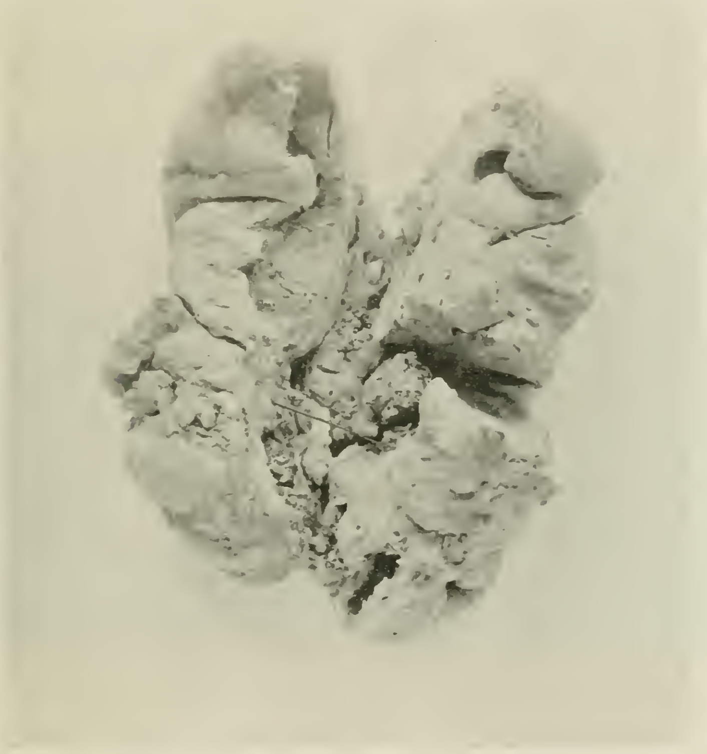
4. This type of growth is seldom seen in patients under forty years of age.

5. Calculi are found in 20 per cent of these cases.

6. Metastases in the bladder and ureter are common.

The following cases present features of unusual interest:

Case 1. G. D. M., referred by Dr. H. J. Sartori. An Italian fisherman, forty-seven years of age, married, entered the hospital complaining of pain in both lumbar regions, worse on the left side and nocturnal frequency of urination. These symptoms began three months before. He had never noticed any blood in the urine, but microscopically, a small number of blood cells, in addition to many pus cells, bacteria, and a heavy cloud of albumin were found. His family history was not significant. He had gonorrhea twenty-three years ago and has had an urethral discharge at intervals since that time. He smoked moderately, but used alcohol constantly, drinking to excess at times. Examination revealed a marked enlargement of the left kidney. Its lower pole extended downward to the crest of the ilium and its inner border to the median line. Culture of the urine showed a colon bacillus infection. The phenolsulphonephthalein output was 25 per cent in the first and 6 per cent in the second hour, total 31 per cent for two hours. The urine obtained from the right kidney following ureteral catheterization, contained an occasional pus cell, that from the left kidney a large number of pus cells. Radiographs of the uninjected kidneys showed enlargement of both kidneys and multiple stone formation in the left kidney. Pyelography revealed an irregular and marked enlargement of the left renal pelvis and obliteration of its calices. The right kidney was also enlarged. A double pelvis and a double ureter were present on the right side, the ureter bifurcating as it crossed the pelvis. Two or three small round shadows were seen at the level of the upper part of the lower pelvis, apparently in its upper calyx. There was some blunting of the calices of this calyx. Operation revealed a markedly enlarged, adherent, pyonephrotic left kidney, with stone formation, calcification

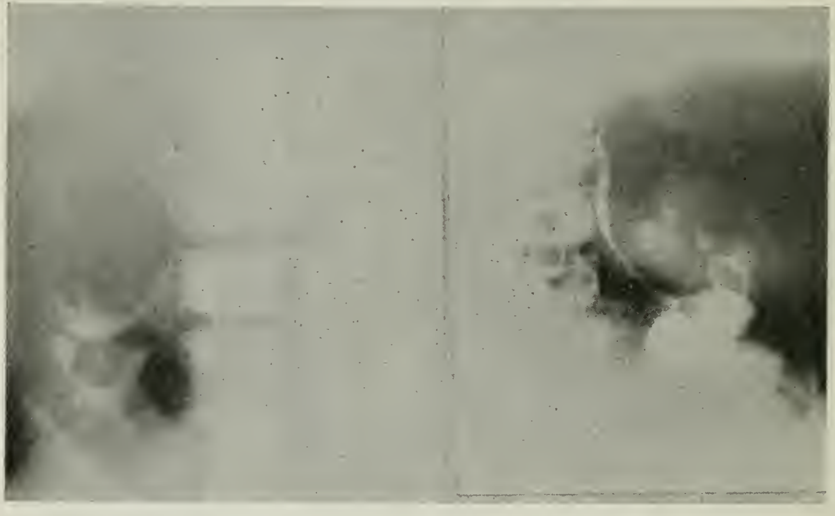


a

Case 1

(*a*) Primary squamous cell carcinoma, nephrolithiasis and pyonephrosis of left kidney.

of the walls of the pelvis and destroyed calices. Several irregularly shaped stones and a large amount of grayish red sand were also present. The kidney parenchyma was firm and fibrous, and somewhat irregular in coloration. Microscopical sections showed part of the normal kidney tissue replaced by heavy fibrous tissue in which were a few spaces filled with remnants of kidney tubules, some collapsed and others containing casts. Large irregular spaces filled with a typical squamous epithelium and epithelial pearls were found in others. There were also many mitral figures present in areas of more recent growth. The growth had developed from the epithelium of the renal pelvis.



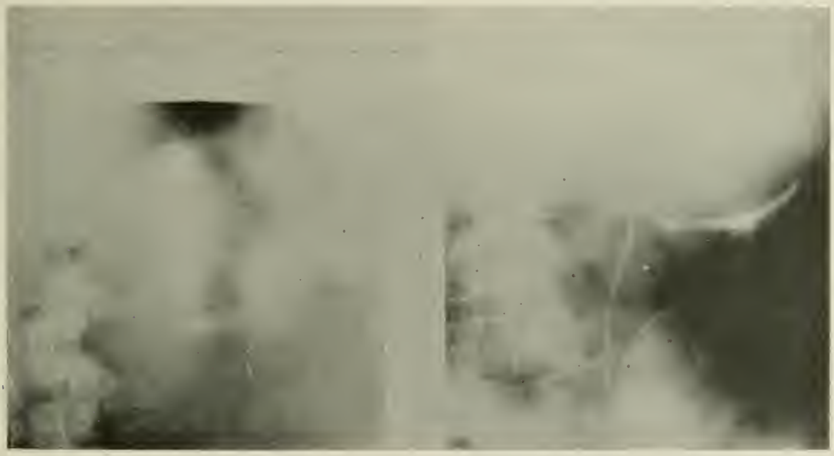
b *c*

Case 1

(*b*) Pyelogram and ureterogram of left kidney
(*c*) Double pelvis and double ureter on the right side

Diagnosis. Primary squamous cell carcinoma, nephrolithiasis and pyonephrosis of the left kidney. Following operation, the patient's condition improved although he still complained of some pain in both lumbar regions. He returned to the country and died three months later of general carcinomatosis.

Comments. Pain, tumor, blood in the urine and deformity of the renal pelvis were present in this case. It is of interest not only because of the marked infrequency of primary squamous cell carcinoma of the kidney—it has been estimated that not over 2 per cent of malignant tumors of this organ are carcinoma—but also because of the interesting anomalies and complications accompanying it. A double pelvis and a double ureter were seen on the right side and the left kidney presented the unusual complex of carcinoma, multiple calculi and pyonephrosis. Chronic inflammatory changes due to nephrolithiasis and infection are probably important factors in the etiology of renal carcinoma. The Mayo Clinic reports that 64 per cent of the cases seen by them were complicated by kidney stones.



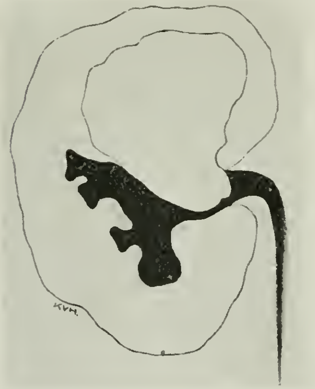
Case 2

(*a*) Flattening of the left renal pelvis and partial obliteration of the calyces due to pressure of the adrenal tumor on the kidney.

(*b*) Pyelogram of the same kidney taken one year later showing more marked flattening of the pelvis and complete obliteration of the calyces.

Case 2. Hypernephroma of the adrenal gland. This condition is rare and it is often impossible of differentiation from a tumor of the kidney. A diagnosis is seldom made prior to operation. The cardinal symptoms of a kidney growth, hematuria, pain, tumor and a deformity of the renal pelvis were all observed in this case. The marked flattening of the renal pelvis, seen in the pyelograms, was due to pressure upon the kidney. Neither the latter nor its capsule were involved in the growth. Many interesting features were present in this case and it will be reported in detail at some future time.

Case 3. M. S., aged seventy, single, a bartender, had suffered from slight pain in the right lumbar region during the past year. He had noticed blood in the urine for the past twenty-four hours. His father had died of "prostatic gland trouble" at seventy years of age, his mother of diabetes at seventy-three, a brother of pulmonary tuberculosis at forty and his other brother of "rheumatism" at fifty-six years of age. He had measles when a child, gonorrhea in 1871 and again in 1904, a genital sore in 1907, and dysentery in 1899. In 1913 he had noticed blood in the urine and was troubled with frequent urination. Cystoscopy at this time revealed a pedunculated papilloma to the left of the left ureteral orifice. The symptoms disappeared following the removal of the tumor with snare and cautery. Nineteen months later, January, 1915, he was in the hospital for two weeks because of severe pain in the right kidney region. His urine contained a trace of albumin, many hyaline, granular and cellular casts, some pus, but no blood cells at that time. Catheterization of the ureters revealed a few pus cells in the urine from the right kidney. The symptoms disappeared following rest in bed. Three years later in April, 1918, he again entered the hospital because of hematuria. Examination of the urine at that time disclosed many blood cells, a trace of albumin and a few pus cells but no casts. Cystoscopy revealed an inflamed bladder mucosa and a somewhat bloody urine escaping from the right ureteral orifice. Comparative functional kidney tests were negative. The urine was free from blood at the end of a week and the patient left the hospital. Six months later he reëntered, stating that he had suffered from slight pain in the right lumbar region for the past year and had noticed blood in the urine for the past twenty-four hours. Cystoscopy again revealed bloody



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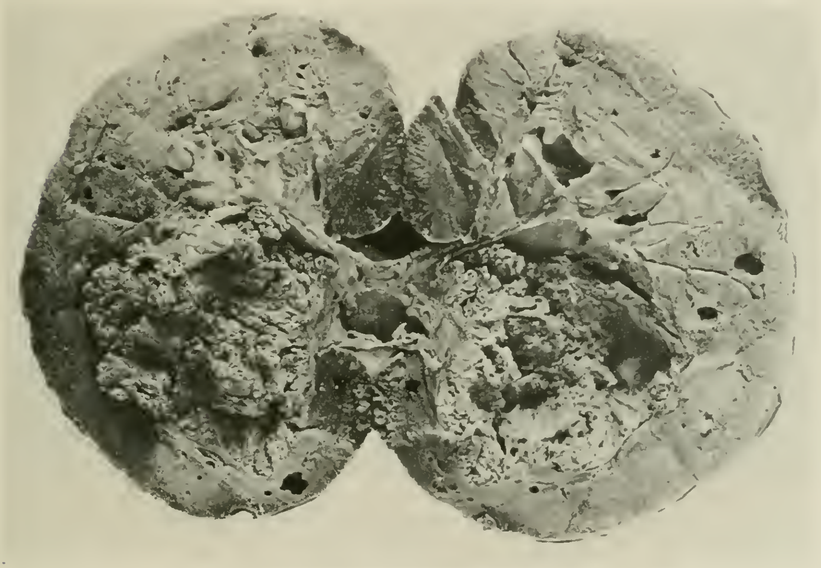
CASE 3

(*a*) Papillary epithelioma of the right kidney pelvis. Pyelogram drawn from memory, original lost.

fluid escaping from the right ureteral orifice. The bladder mucosa was normal. Functional kidney tests gave diminished values on the right side. Radiography and the wax-tipped catheter showed no evidence of calculi. Pyelography demonstrated the right kidney pelvis to be somewhat elongated laterally and the ureter entering the pelvis at a right angle. A diagnosis of tumor of the kidney was made and operation advised and accepted. A large papilloma, the size of a walnut, was found when the pelvis was opened. No evidence of ureteral involvement was present. Fourteen months later he again entered the hospital complaining of slight pain in the right lumbar region at the site of the old scar. He stated that he had been in excellent health since the operation. Cystoscopy revealed a small sessile papilloma at the site of the right ureteral orifice. No other symptoms were present. The papilloma was fulgurated. Nine months later he reëntered the hospital for examination. He had been obliged to urinate once during the night for the last two or three months and still had slight pain in the right lumbar region. The papilloma, which



b

Case 3

(*b*) Papillary epithelioma of the right kidney pelvis.

was a little larger than at previous examination, was again fulgurated. Nine months later he again entered the hospital for examination and treatment. He had passed considerable bright red blood a few days before but otherwise had been in excellent health. The papilloma was about the same size as at the last examination and was again fulgurated. One week later, radium was applied to the tumor for one hour. Up to the present time the papilloma has been fulgurated seven times and radium applied on six different occasions.

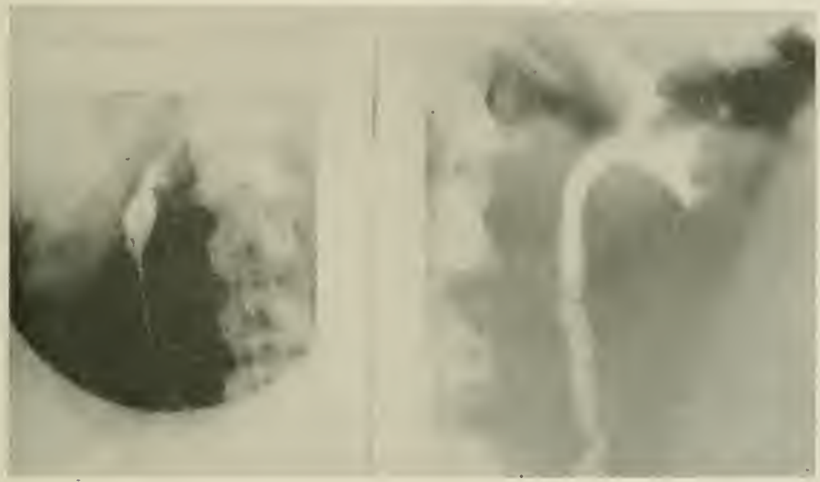
Diagnosis. Papillary epithelioma of the renal pelvis.

Comments. Notwithstanding the apparent freedom from ureteral involvement and the removal of as much of the ureter as possible through the nephrectomy wound, total ureterectomy as now generally advised, would perhaps have been the better surgical procedure. This question is debatable however, in the light of the subsequent course of the case. To begin with, the patient was seventy years of age at the time of nephrectomy, and ureterectomy would have added materially to the risk of the operation. The man is now seventy-four years of age and apparently in good health. He has gained in weight and states that his health is better than it has been in many years. Although this case has been reported on a previous occasion, I have taken the liberty of again calling attention to it, not only because of the infrequency of papilloma of the renal pelvis, but also because of the subsequent interesting developments.

Case 4. From the Genito-Urinary Department of the San Francisco Polyclinic. Mrs. K., aged sixty-three, widow, complained of pain in the left lumbar region and painful urination following an automobile accident ten weeks before. She had "hepatic calculi" twelve years before; otherwise her past history as well as her family history, was not significant. She had occasionally noticed blood in the urine for many years. Both kidneys were palpable; the right somewhat sensitive. A catheterized specimen of bladder urine contained a few blood cells and a trace of albumin. Cystoscopy revealed an inflamed bladder mucosa. Both ureters were catheterized to the pelves of the kidneys and specimens obtained for examination. That from the right kidney contained a moderate number of pus cells but no blood cells, that from the left contained a large number of pus cells and a few blood cells. Stained specimens or urinary sediment and inoculated guinea-pigs were negative for tuberculosis. Cultures showed staphylococcus albus in the left kidney urine while that from the right was sterile. Functional kidney tests revealed very little function on the right side but good function on the left side. Radiography and pyelography showed a markedly filling defect of the right kidney pelvis and a large coraliform stone, together with several smaller stones in the left kidney pelvis.

Diagnosis. Probable tumor of the right kidney, nephrolithiasis of the left kidney.

Comments. An interesting feature of this case is the question of treatment. As mentioned above, the function of the right kidney is poor and the loss of the left kidney, not improbable, following the removal of such a large stone, would prove fatal. Some improvement followed lavage of both kidney pelves with silver nitrate solution. The patient is now being treated in the town where she resides, as she finds the journey to San Francisco too much of an exertion.



Case 4 Case 5

Case 4. Probable tumor of the right kidney.
Case 5. Tumor of the left kidney.

Case 5. H. S., aged twenty-nine, single, occupation suit cutter, entered the out patient department of Mount Zion Hospital complaining of pain in the hypogastric and left iliac regions and painful and frequent urination of two months duration. He also complained of swelling of the left testicle, of four days duration. The pain and frequency followed a cystoscopic examination. He was told that he had cystitis and that the right kidney was "out of function." No improvement followed bladder irrigations and internal medication. He had gonorrhea four years before and had been treated at intervals since that time. Examination showed an epididymitis on the left side and a somewhat tender, infected prostate gland. The Wassermann was negative. A catheterized specimen of urine contained a large number of pus cells, a few blood cells but no tubercle bacilli were found. Cystoscopy revealed a somewhat infected bladder mucosa. The urine from both kidneys contained a large number of pus cells. Culture showed a bilateral colon bacillus infection. Functional kidney tests revealed a marked diminution of function on the right side. The kidneys were normal in size and position but pyelograms demonstrated a long, narrow pelvis displaced laterally on the right side, with calices obliterated, and on the left size a small pelvis with some narrowing and elongation of the major calices.

Diagnosis. Tumor of the right kidney with pyelonephritis of both kidneys.

Comments. As in the two preceding cases, the question of treatment is of much interest. Very little relief followed lavage of this patient's renal pelves. Because of the questionable condition of the left kidney, I have not considered a right sided nephrectomy advisable.

Case 6. Referred by Dr. R. Pietrafessa. A married Italian bootblack, aged twenty-seven, complained of frequent urination during the day and urgency of six weeks duration. He had lost 10 pounds during the past year. He denied venereal disease. There was a suspicion that both of his parents had pulmonary tuberculosis. The two-glass test showed an equally large number of pus cells in both specimens of urine. No blood cells were present and no tubercle bacilli were found. Urethrascopy showed an enlarged, irregular verumontanum, with a small papilloma on its left side. Cystoscopy revealed a slightly infected bladder mucosa. The urine from the right kidney was microscopically negative, that from the left kidney contained a large number of pus cells. Functional kidney tests gave about equal values on both sides. Nothing abnormal was seen on ordinary radiography but pyelography revealed a marked narrowing, undoubtedly due to pressure on the calices of the left renal pelvis, and a dilated left ureter. The patient's symptoms improved following fulguration of the verumontanum including the papilloma and four irrigations of the left renal pelvis with silver nitrate solution. There was a marked decrease in the number of pus cells found in the left kidney urine and the frequency and urgency disappeared, but the patient complained of more or less weakness and his weight remained stationary. He disappeared at the end of three weeks and has not been seen since that time.

Diagnosis. Tumor of the left kidney. Papilloma of the verumontanum. Verumontanitis.

Comments. Notwithstanding the absence of the three cardinal symptoms, the evidence produced by the pyelograms justifies the diagnosis of real tumor.

This kidney should be removed.

TREATMENT

In deciding upon the treatment of a malignant tumor of the kidney it must be remembered that, although an occasional report of the spontaneous cure of hypernephroma has been recorded in the literature, the prognosis with this, as with all malignant tumors, is usually hopeless without operation. In view of this fact, the kidney should be removed in almost every instance, unless associated with definite metastases. Even in the presence of this condition, severe pain, intestinal obstruction or hemorrhage sufficiently profuse to threaten the life of the patient, are indications for operation. A single metastasis which is accessible, is not a contraindication to surgical interference but should be removed at the time of the nephrectomy. Michaelsson of Stockholm reports 7 of 30 patients operated upon for hypernephroma of the kidney alive fifteen, twelve, nine, seven and four years after operation. The difficulties encountered in the removal of malignant tumors of the kidney are due to adhesions, friability and to the large size of the growth. If the fatty capsule is involved, it should be removed with the kidney. This necessarily includes the removal of the suprarenal capsule. The lumbar or extraperitoneal route is preferable for the removal of small or medium sized tumors and the abdominal route for large growths. The complete operation involves the removal of the kidney, the perinephritic fat together with the suprarenal capsule and the lymphatic vessels and glands in one mass. The incision best suited for this purpose consists of a vertical portion which runs from the tip of the eleventh rib to a point just behind the anterior, superior spine of the ilium; from either end of this an incision is carried forward, one following the costal margin, the other the crest of the ilium. The length of these incisions depends upon the size of the tumor. A flap consisting of the whole thickness of the belly wall is thus turned forward from the flank. This incision gives an excellent exposure of the kidney and its pedicle. In all operations the renal vein should be ligated as far from the kidney as possible. Early ligation is likewise advisable, as it prevents the squeezing of the malignant cells into the general circulation following the manipulation of the kidney.

In papillary epithelioma of the renal pelvis the entire ureter should usually be removed with the kidney as involvement of the ureter occurs later, if not already present.

Some favorable results have been reported following the use of radium packs and from intensive treatment with massive doses of deeply penetrating x-rays obtained from high voltage apparatus. These procedures are certainly worthy of trial both preceding and following operation as well as in inoperable cases.

FURTHER OBSERVATIONS ON THE BLOOD PRESSURE IN CASES OF URINARY OBSTRUCTION[1]

VINCENT J. O'CONOR

Chicago

Received for publication July 6, 1922

This report comprises the results of the study of 74 patients with urinary retention due to obstruction at the vesical neck.

The blood pressure changes occurring during the hospital management of 56 of these cases have already been compiled in a previous contribution on this subject. Further study has been interesting from both a clinical and experimental point of view and careful analysis of the results as a whole have led us to conclusions of some practical importance.

The original plan of securing this data was followed. Prior to the estimation of the amount of residual urine, the blood pressure reading was recorded. A blood pressure reading was made every twenty-four hours for four days, and then every second day during the patient's stay in the hospital. Whenever possible the same house officer made all the readings throughout the entire hospital management of the individual case. He used the same standard type of mercury manometer to record all of the readings.

EFFECT OF DRAINAGE OF THE BLADDER

Sudden fall in blood pressure

When the bladder is kept at complete rest by an indwelling catheter, or by suprapubic cystotomy, a very appreciable fall in blood pressure occurs during the first twenty-four hours. In a series of 60 cases the average fall in systolic blood pressure was 44 mm. of mercury at the end of this time. The average fall in diastolic blood pressure was 15 mm. of mercury.

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[1] Read before the Chicago Urological Society, May 18, 1922.

The most marked diminution occurred in those patients who presented themselves with a marked hypertension, in nearly every instance associated with a considerable amount of residual urine (400 cc. or more). To a great extent the degree of fall seemed to depend almost entirely on two things: the quantity of residual urine; and the degree of reduction of renal function. The presence or absence of infection of the urinary tract made no obvious difference in the degree of blood pressure change, nor was there any relative difference noted between those patients drained by suprapubic cystotomy and those in whom drainage had been established by an inlying urethral catheter. In all cases, when possible, the patient was urged to sit up in a chair for a time each day, and in most instances to walk about.

The greatest drop in systolic pressure during the first twenty-four hours after constant drainage was 85 mm., and in diastolic, 45 mm. In 25 per cent of the cases there was no fall in diastolic pressure at all, although 15 per cent of these patients had an appreciable decrease in the systolic pressure.

In no instance did the blood pressure readings show an elevation on the second day as compared with the first day after keeping the bladder at rest. In 65 per cent of the cases the systolic blood pressure continued to fall during the second twenty-four hours with an average of 15 mm. of mercury. In 40 per cent there was no further reduction in systolic pressure and in 85 per cent no decrease at all in diastolic pressure during this time.

There was no further fall in blood pressure in 75 per cent of these cases after the second day of drainage. However, in the remaining 25 per cent the pressure did continue to fall for one or several days and averaged a total decrease during this time of 15 mm. of mercury.

In a more recent series of 8 patients, each of whom had 500 cc. or more residual urine, a method was adopted for gradually emptying the bladder by reducing the level of the drainage tubing over an elbow attached to the foot of the bed. Blood pressure readings could be made twice daily. The tube was lowered so that in each instance the bladder was entirely emptied on the seventh day. This method has no advantages over the older and more simple one of clamping the tubing and allowing a given amount of urine to escape at regular intervals. It was merely used for comparison of blood pressure chartings. In 6 cases the systolic blood pressure dropped on an average of 40 mm. in the first week; but during no twenty-four hour period was there noted a decrease of more than 10 mm. In none of these 6 was there any apparent untoward effect from bladder drainage; 4 having been relieved by indwelling catheter, and 2 by suprapubic cystotomy.

The subsequent systolic blood pressure rose on an average of 15 mm., during the second week before it regained an equilibrium.

In the other 2 individuals there was little or no fall in pulse pressure after drainage had been established through a small suprapubic incision, the catheter being clamped and only 60 cc. of urine allowed to escape each hour. These patients were kept on a constant fluid of intake of 3600 cc. in the twenty-four hours. At the end of the fourth day the bladder was constantly empty.

Six cases were given 1000 cc. of 4 per cent glucose solution intravenously before draining the bladder. Three of these were relieved by suprapubic cystotomy and 3 by indwelling catheters. All had a residual urine of more than 350 cc. This estimate was made by completely emptying the bladder at the initial drainage. The exact quantity of 2 per cent boric acid solution, sufficient to replace the residual urine withdrawn, was then introduced and the catheter was clamped. Subsequently the bladder was gradually emptied for a period of five days. None of these patients had a rapid fall in blood pressure and each established a fixed level with the maximum return of renal function in from ten days to two weeks.

This latter procedure is by far the most ideal one for instituting primary drainage in individuals of unstable condition. It makes no apparent difference whether the route of the drainage itself is per urethram or suprapubic, providing it is ultimately complete.

It was early noted that patients operated on at a time when the blood pressure was still showing a slight decrease each day, even though the pressure was accompanied by satisfactory renal function, showed a postoperative fall in blood pressure greater than seemed normally commensurate with the degree of operative disturbance.

This suggested the possibility that we were operating on these patients without a sufficiently prolonged preoperative management, despite that fact that their general condition seemed satisfactory and their renal function entirely adequate. So, after this observation and in order that we might draw conclusions, no patient was operated on until his blood pressure had maintained a definite level for at least four days.

Establishment of a fixed blood pressure level on continued drainage

When the patients were kept on a satisfactory drainage, 50 per cent of them had a subsequent rise in blood pressure after the period of decline. This average rise in systolic pressure was 20 mm. and in diastolic, 5 mm. of mercury.

In all but 4 patients observed, the blood pressure reached a constant level in from four days to two weeks and did not vary from this level over 5 mm. of mercury in the daily readings regardless of the duration of the drainage period. It must be emphasized, however, that any interruption, or insufficiency, of drainage for a period of more than from six to eight hours will frequently bring about very marked and rapid changes in the blood pressure and renal function. In the rare instance in which this interruption occurred, a reproduction of the entire series of relative blood pressure changes occurred in the same manner as when the patient was first placed on drainage, except that a fixed level was reached in a much shorter period of time.

The conclusions to be drawn from these observations are that on continued drainage of the bladder the blood pressure within two weeks maintains a level, or "equilibrium," at which time the renal function is restored to the greatest extent possible, and that the patient is in the best general condition for operation. This new level is in the great majority of instances a definitely lower one than that existing before drainage was established.

Postoperative fall in blood pressure

In the 8 cases in which operation was performed while the blood pressure was still falling, the decrease in systolic pressure during the first twenty-four hours after operation averaged from 90 to 30 mm.of mercury and from 40 to 15 mm., diastolic. There was therefore a considerable reduction in the pulse pressure, and rigorous postoperative management was necessary to return these patients to a normal convalescence. Whereas in those patients who had been prepared for operation until the blood pressure had maintained a definite fixed level, the degree of postoperative fall was surprisingly insignificant especially when 500 cc. of 4 per cent glucose solution was given intravenously both before and after the operation.

The continuous intravenous injection of glucose solution during the operation itself did not seem to be more advantageous than the introduction of a similar amount half of which is given before, and the remainder after, operation.

This latter conclusion is based however, upon a comparative study of only 8 cases; 6 of which were suprapubic, and 2 perineal prostatectomies.

Subsequent blood pressure

The most interesting of all the phases of the blood pressure variations in this class of cases is that of the relationship persisting after discharge from the hospital. In about 35 per cent of the cases the patients who originally presented themselves with a definite hypertension have, since operation, maintained a normal blood pressure ratio over periods of one to two years. This return of the blood pressure to normal has occurred regardless of age, or the presence or absence of urinary infection, or the original degree of hypertension. Two patients in this class, who had only minor urinary symptoms with an initial residual urine of less than 2 ounces, have maintained normal blood pressure ratios after complete relief of a "median bar" type of obstruction. Before the original bladder drainage the systolic pressure had repeatedly been above 200 mm. of mercury.

SUMMARY

1. Complete drainage of the bladder in patients suffering from urinary retention is attended by a marked fall in systolic blood pressure during the first forty-eight hours. During this period the renal function is diminished as shown by the phenolsulphonephthalein test and the quantitative determination of urea in the blood. If, however, the retained urine is gradually evacuated the decrease in pulse pressure will be less marked and the renal function only slightly diminished.

2. Before instituting permanent drainage all patients in a "pre-uremic," or "dehydrated" condition should be amply supplied with fluid. This can be quickly and safely accomplished by the intravenous injection of glucose solution.

3. If satisfactory drainage of the bladder is continued, the blood pressure is gradually maintained at a definite, nonfluctuating level. During this period the adequacy of the renal function and the general condition of the patient indicate that he is in the best possible condition for operation.

4. Patients prepared for operation by waiting until this fixed blood pressure level has been established have shown a very insignificant postoperative decrease in blood pressure, especially when glucose solution is given intravenously both before and after operation.

5. The majority of these patients who had suffered from long standing urinary retention, and who originally presented themselves with a hypertension, have continued thus far to be relieved of their abnormally high blood pressure except in a few instances in which demonstrable cardiac disease existed.

6. Obstruction in the course of the urinary tract must be considered, in many instances, as a cause *per se* of high systemic blood pressure. This may be equally true even though the residual urine is small in amount.

A SIMPLE TREATMENT OF CERTAIN LESIONS OF THE INTRAVESICAL URETER IN THE FEMALE

EDW. J. HARNAGEL

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Surgeons have long observed in the course of operations on the urinary bladder the considerable mobility of the terminal part of the ureter and urologists unanimously will testify to this freedom of movement which often defeats their most painstaking efforts at ureter catheterization. In fact it is only within a short radius of the internal meatus that the bladder itself is fixed or comparatively immovable—other parts may readily be drawn with Young's rongeur, in the female, through the urethra quite to the external meatus. This mobility can be turned to a neat therapeutic advantage as is demonstrated in the two cases reported below.

Case 1. Left uretero-vesical cyst.

Mrs. L. B., age thirty-seven, bookkeeper, referred July 22, 1917, by Dr. George Sanders, of Des Moines, for urologic examination, presented briefly the following instructive history: Good health until sixteen or eighteen of age, when she noticed an increasing frequency of urination which later became associated with pain and at times even tenesmus, with cloudy urine and other symptoms of cystitis. Occasionally she would be unable to void, yet a few minutes later could empty the bladder as readily as ever. Meanwhile a dull aching and at times severe pain appeared in the left lumbar and inguinal regions which eventually became a persistent daily feature. Two suprapubic gynecologic operations were done without changing any of the symptoms mentioned but added thereto those of abdominal adhesions and a violent dysmenorrhea. Finally in an operation two years ago the remaining pelvic organs were removed, which cured the later-added troubles and left the patient with only the original symptoms; from these she still seeks relief. Cloudy urine has been constant for years but it has been bloody only after instrumentation. There have been no chills and the patient is uncertain as to fever. Cystoscopic and X-ray examinations made three months ago are said to have been unsatisfactory.

Physical examination. Moderately built woman, looks worried rather than ill. General examination is practically negative. The abdomen shows the scars of previous operations. The left lumbar region and left groin are tender to deep pressure but no mass is felt. Left kidney not palpable, the right can just be felt. Pelvic examination: cervix present, uterus absent, otherwise negative. Urine examination shows an abundance of pus cells.

Cystoscopic examination. Light chloroform anesthesia (patient insisted upon a general anesthetic). No. 24 Brown-Buerger cystoscope passed with ease. General chronic cystitis. Right ureteral orifice thickened like the bladder mucosa; left ureter not seen. No stone, no neoplasm. While again surveying the left side of the bladder a spherical cyst-like structure loomed up from the left ureter region (fig. 2a); it was about the size of a large walnut but changed its size and tension with the abdominal pressure during respiration, wrinkling and almost disappearing, then rapidly ballooning; when fully distended it reached beyond the middle of the trigone.

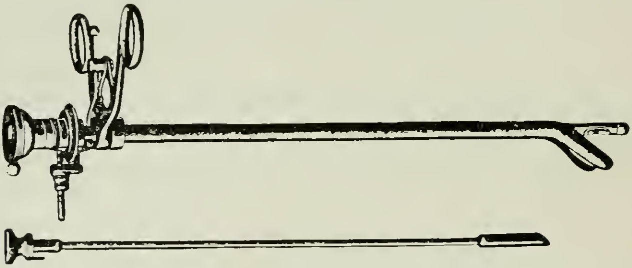

Fig. 1. Young's Cystoscopic Rongeur, Obturator Withdrawn, Cystoscope Introduced, Blades Open

Treatment. The cystoscope was removed and Young's cystoscopic rongeur (fig. 1) introduced. The widely opened jaws were made to grasp generously and firmly upon that part of the cyst wall which projected farthest into the center of the bladder (fig. 2 b). Holding the instrument steadily in this position, the light was detached, the telescope was slipped back, and then by gentle, steady traction (at the same time rotating the handles downward—"axis traction") the apex of the cyst was drawn well out through the urethra (fig. 2 c) and with curved scissors cut off at the external meatus while the base disappeared into the bladder. The piece of cyst wall thus excised measured 1.5 by 2 cm, was smooth on both sides, and near one end was found the obliterated orifice of the left ureter.

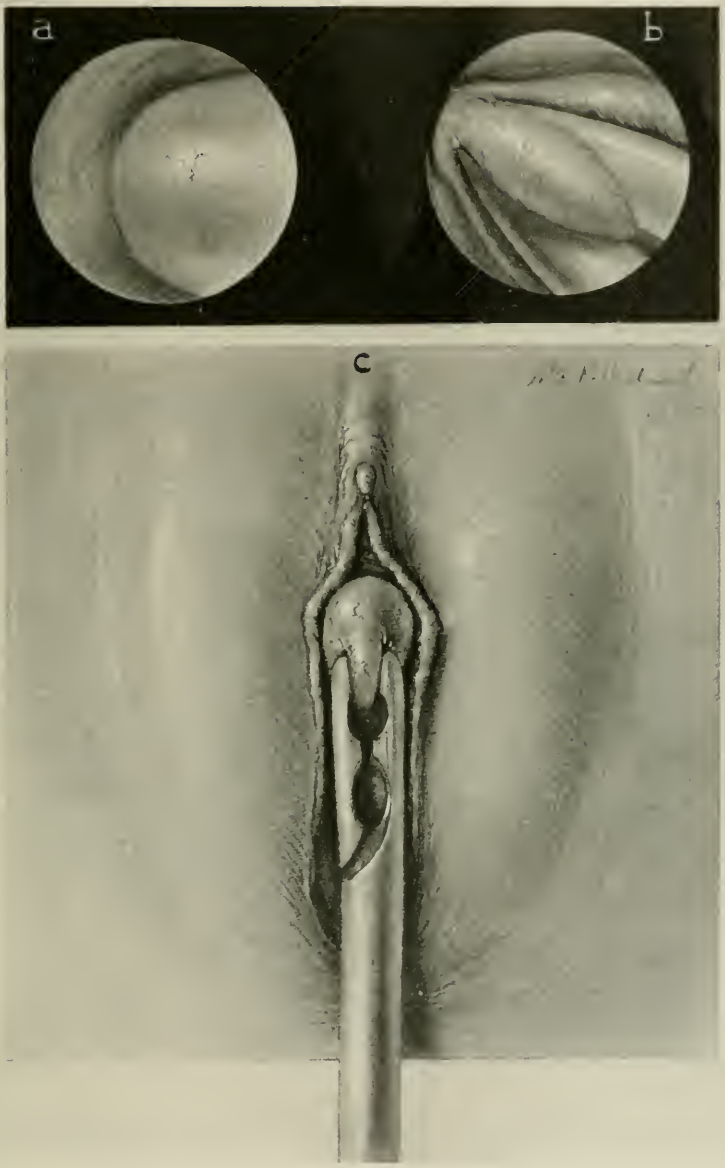

Fig. 2. (*a*) Left Uretero-Vesical Cyst, Bladder Mucosa Injected as in Chronic Cystitis. (*b*) Rongeur Grasping Apex of Cyst. (*c*) Apex of Cyst Drawn out Through Urethra by Rongeur Forceps

The cystoscope was now replaced. Very slight bleeding had occurred. The remaining walls and base of the cyst had retracted to a low vertical fringe encircling an irregularly round ureteral opening which was nearly a centimeter in diameter. A calculus was seen at the opening but it dropped back into the ureter and out of sight. Above the bladder the ureter was widely dilated. No further investigations were made. Several hours later 7 calculi varying in size from small to large peas were voided with the urine. The patient returned to her office work three days after the operation. The relief has been permanent; hence, notwithstanding some residual symptoms referable to the left side, no further examinations have been secured.

The destruction of this uretero-vesical cyst required possibly five minutes after the diagnosis by means of the cystoscope had been made.

Comparison with other methods of treatment need not be dwelt upon, but a brief review may be of interest.

Approximately 100 cases of uretero-vesical cyst have been reported. Half of them were post-mortem observations and of these a majority occurred in infants or very young children. To date the females affected have well outnumbered the males. In 6 cases the cystic dilatation protruded spontaneously from the urethra (Geerdts, Caille, Johnson, Haushalter and Jacques, von Hibler, and Pietkiewicz); the patients were, of course, all females, five young children and one adult.

The first operative report came from Grosglik in 1901. His method consisted in suprapubic cystotomy, resection of the cyst near its base, and suturing together the resulting mucous edges. This procedure has since been the one employed by the suprapubic route and is apt to be the one of choice in male patients. Garre, Madelung, Eisendrath, Pietkiewicz, Feforoff, and Dieckerhoff operated suprapubically and the last named recently designated this the preferable mode of attack.

Fenwick in 1903 operated successfully by way of the urethra. Hunner in 1902 resected a cyst through a vesico-vaginal incision. Kelly completely relieved his patient by simply making a short slit in the cyst wall with delicate scissors through his urethral endoscope. By the same route Caulk operated two cases using both cystoscope and scissors through the urethra. Wulff opened a cyst widely with the cautery of an operating cystoscope. Klose also employed the cystoscope cautery followed by a stiff catheter. Young destroyed the cyst in a man of forty-nine by means of his cystoscopic rongeur. Buerger successfully treated his patient, a man of thirty-six, by using a knife and punch-forceps through the operating cystoscope. Also nephrectomy with ureterectomy has been done without disturbing the cyst, resulting in partial or complete relief of the symptoms. Caulk and Dieckerhoff cite cases in which mere slitting or puncture of the cyst failed to effect a permanent cure. Blum operated 2 cases (1 bilateral) by Grosglik's method, 2 by fulguration, 1 by nephrectomy, 1 by ureteral catheterization and sounding, and 1 containing a calculus ruptured spontaneously.

The results by all these types of operations have been good; the prognosis depends chiefly upon the previous condition of the kidneys, especially that of the opposite side.

Case 2. Calculus in the right intravesical ureter.

Mrs. A. F. W., age forty-eight, referred by Dr. O. J. Fay, Des Moines. The patient is a large, stout woman, the mother of five children all now young adults. She enjoyed exceptional health until three years ago; since then she has suffered repeated classical and severe attacks of right-sided renal colic, the last attack occurring one week ago. A clinical diagnosis of nephro- or uretero-lithiasis was made. Roentgenographic examination of the urinary tract showed a single, oval, well-marginated shadow in the bladder area an inch to the right of the mid-line By cystoscopy the intravesical ureter was found distended by a stone lodged 1 cm. above the ureteral orifice (fig. 3 a).

Treatment. The cystoscope was removed. Chloroform administered to light anesthesia. With Young's cystoscopic rongeur the ureter and stone were grasped (fig. 3 b), the light detached, the telescope partly withdrawn, and by slow traction and depressing the handles the ureter and the stone within it were readily brought to the external meatus; a long longitudinal slit was made in the ureter between the jaws of the rongeur, then the pressure was slightly lifted, thus releasing the ureteral walls which disappeared into the bladder, leaving the stone within the hollowed jaws. The stone measured 5x5x8 mm. There was very slight bleeding. Recovery, since it concerned only the anesthesia and slight urethral soreness, was prompt, complete and permanent.

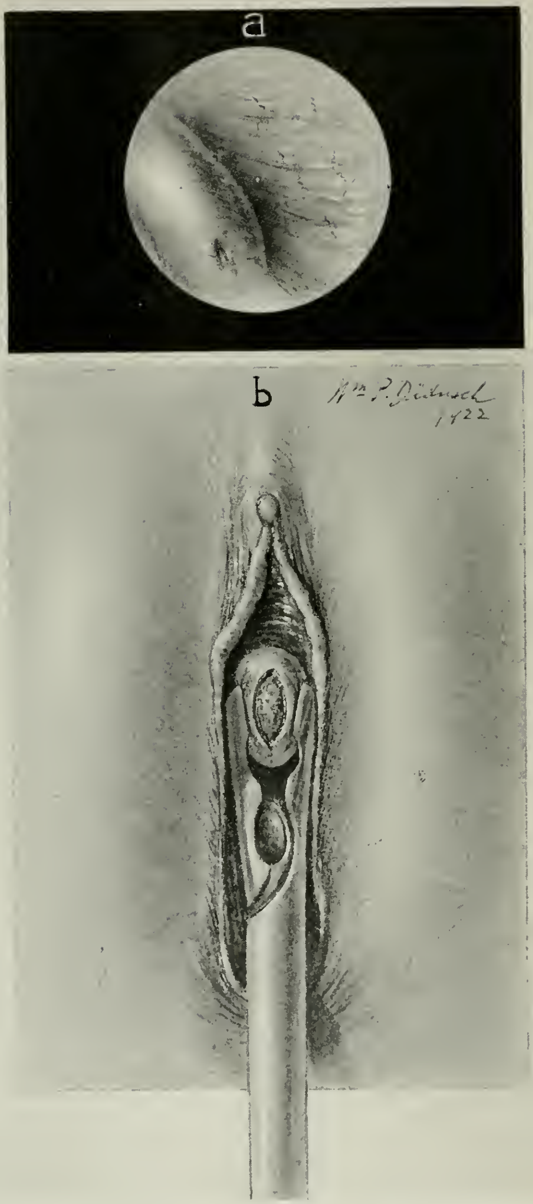

FIG. 3. (*a*) CASE 2. CALCULUS IN RIGHT INTRAVESICAL URETER. (*b*) INTRAVESICAL URETER CONTAINING THE CALCULUS BROUGHT TO EXTERNAL MEATUS

Incision made for removing calculus

Endovesical extraction of ureteral calculi still justly retains its lure. Its advantages from the patients' standpoint are manifold. However, the innumerable variations and difficulties encountered render the heretofore described methods tedious and dubious even with the best technical skill. Ureteral dilatation by multiple catheterization or by sounding, oil injections, the flexible forceps, and other highly specialized methods have each brilliantly succeeded and honorably failed. Therefore the writer particularly emphasizes the case above as the type for which he enthusiastically recommends the procedure employed in its treatment.

In conclusion it is desired to direct attention especially to the simplicity of the treatment described for these two varieties of lesions of the intravesical ureter, and in no less degree to the almost immediate recovery of the patient.

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EPISPADIAS IN WOMEN[1]

REPORT OF A CASE

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That epispadias in the female is of exceedingly rare occurrence is evidenced by researches into the literature in which we have been able to find reports of only 43 cases. Even among these few there seems to be some difference of opinion as to whether or not all were cases of true epispadias. In fact, there seems to be a considerable difference of opinion as to the exact nature of this anomaly, and many of the textbooks on genito-urinary diseases either omit any mention of the occurrence of this abnormality in women, or else make the definite statement that it occurs only in the male.

According to Ballantyne (1) male and female epispadias do not correspond, the deformity in women consisting essentially in a displacement of the urethra to a point above the level of the clitoris, the bladder walls are intact and the symphysis is closed. It is these latter conditions which differentiate the condition from exstrophy in which there is a defect in the bladder wall and the symphysis is divided. Mayersbach (2) follows Durand and Guyon's division of the various stages of the malformation into four groups:

> 1. Corpus cavernosum of the clitoris is separated and the urethra merges into the dorsum of the clitoris and resembles more or less the epispadias in the male. This modification occurs more rarely.
>
> 2. The urethra merging into the split dorsum of the clitoris, shows various great defects of its anterior (posterior) wall.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

3. Any trace of an anterior urethral wall may be lacking and this condition is usually associated with a prolapse of the bladder mucous membrane.

4. Complete abdominal fissure which communicates with the urinary bladder. The symphysis is not closed, the anterior abdominal wall is cleft as far as the bladder cavity; the bladder mucous membrane itself is prolapsed.

The forms of epispadias in the female which occur most frequently fall in groups 2 and 3 and present a rather similar appearance.

Stiles (3) describes the different forms of the lesion in the order of their severity as

> Partial epispadias, where the deeper part of the dorsal wall of the urethra is developed; complete epispadias, where the dorsal wall is entirely absent; and sub-symphyseal extroversion, where the sphincter at the neck of the bladder is deficient and there is more or less protrusion below the symphysis of the mucous membrane of the posterior wall of the bladder.

Whatever classification one may adopt, however, has but little bearing upon the treatment to be offered. In any case the outstanding difficulty for which relief is sought is the incontinence of urine, and the method of establishment of an effective means of control does not depend upon the extent of the deformity.

Ballantyne (1) adds to his report of a personal case an analysis of 33 cases reported in the literature. He considers that *14* among these were cases of genuine epispadias; 16 he considers should more properly be classed as cases of "sub-symphysial exstrophy," while in the remaining 3 the classification was uncertain.

Mayersbach (2), writing twelve years later, makes the statement: "Twenty-four cases from the literature, up to 1904, have been reported by Gütschow. To these only a few new ones have been added."

Nové-Josserand and Cotte (4), in 1907 report records of 30 cases to which they append a case of their own.

Accepting Nové-Josserand and Cotte's (4) figures and adding their own case, 1 reported by Mayersbach (2) in 1908, 1 by Göbell in 1910; 2 cases by Stiles (3) in 1911, 1 by Wertheim (5) in 1919, 6 by Schmidt (6) in 1920 and 1 by Reifferscheid (7) in 1921, the total number of reported cases to date would be 43, although as we have stated above there would appear to be some uncertainty regarding the exact classification in all these cases.

ETIOLOGY

As to the developmental conditions which are responsible for this anomaly, we can do no better than quote from Ballantyne (1):

> Chiefly through the researches of F. Tourneux, considerable light has been thrown upon the development of the external genitals. The anal plate which closed in the posterior end of the embryo becomes much thickened, so as to form a mass of epithelial cells which constitutes a sort of plug. The greater part of this plug is called by Tourneux the *bouchon cloacal*, and it intervenes between the lower end of the urogenital sinus and the exterior, and thus shuts in the sinus. On its ventral aspect is an accumulation of cells of the mesenchyma which forms the external prominence known as the genital tubercle, the future clitoris or penis. By the disappearance or breaking down of the cells of the 'bouchon cloacal' the urogenital sinus comes to communicate with the exterior by means of the vulvar and urethral apertures which are thus formed. A prolongation forward of the "bouchon" or plug causes, by its subsequent breaking down, a grooving of the under surface of the genital tubercle, and so leads to the later formation of the urethral canal and vestibule. This prolongation has been called the "urethral lame" by Tourneux, and it is to this structure that we must look for an explanation of the origin of epispadias and vesical exstrophy. According to Durand, the undue extension forward of this "urethral lame," and its groove or orifice-making powers, leads to an increase in the size of the anterior part of the aperture by which the urogenital sinus is put into communication with the exterior. "The urethral walls are, therefore, imperfectly formed, and epispadias is produced and the clitoris is split. A more marked extension of the "lame" results in the production of an orifice in the anterior bladder wall (sub-symphysial vesical exstrophy); and a still farther extension prevents the closure of the symphysis pubis and the anterior abdominal and vesical walls (vesical exstrophy). This theory may or may not be correct but it has the advantage of explaining in a rational way both epi- and hypospadias and vesical exstrophy.

TREATMENT

As the causative factor in these cases is out of our control it is to the correction of the condition, especially to the restoration of function, that our attention must be directed.

Ballantyne (1) reports the results of plastic surgery as complete cure in 4 cases, great improvement in 8, and amelioration in 3. In none of these cases were the ureters transplanted.

Gersuny (8) reports a successful result from torsion of the urethra, along its longitudinal axis. He made 3 successive operations, in each of which the urethra was twisted through half a circle, and fixed each time in its new position. Continence for five hours was the result of this procedure.

Wojciechowski (9) performed a similar operation making a torsion of the urethra of only 90 degrees, with a like satisfactory result. These end results would appear to have been the best secured by any of the methods used prior to Stiles (3) in his 2 cases in which he transplanted the ureters into the lower part of the pelvic colon. Stiles (3) thus summarizes the prior methods:

> The various methods employed have consisted either simply in narrowing the urethra or in combined narrowing with lengthening. The narrowing was effected either by simple cauterization, by suturing the raw edges obtained by lateral incisions, by urethral colporraphy, or by a plastic operation combined with torsion. A combination of lengthening and narrowing of the urethra was attained in one of three ways: (1) by dissecting down a triangular flap from the muco-cutaneous trough above the abnormal meatus so as to restore the superior wall of the urethra; (2) by the formation of two lateral flaps combined with supra-urethral colporraphy; (3) by combining lengthening with torsion of the urethra.

Schmidt (6) reports satisfactory results in 4 of his 6 cases, 3 of which he reports as complete epispadias and 3 as of "grades 2 and 3," as the result of the construction of an effective sphincter by the method of Goebell-Stoeckell (10). In most of these cases, however, the patients were followed for but brief periods after operation or else the period of cure is not stated. The crucial question is: For what length of time were these methods effective?

In Stiles' (3) 2 cases, excellent results were secured. The first, one year after operation, was completely continent during the day, but occasionally wet the bed at night; the second, three months after operation had "complete continence both day and night;" and in a personal interview a few months ago Stiles (3) refers to one of these cases as still in excellent condition, i.e., eleven years later.

AUTHOR'S CASE

My own case, a woman, thirty years of age, consulted me first in October 28, 1921, complaining of a small lump in her groin, which had been gradually increasing in size during the preceding six months—with accompanying periods of cramplike pains, nausea and vomiting. During these periods the lump which proved to be an inguinal hernia would rapidly enlarge, was sometimes bluish in color and would become very tender. The patient reported that she had never had any control of her urine. Further inquiry elicited the fact that when she was about one year old her parents first realized that the urine was trickling continuously and noted the exposure of a raw surface where the urethra should be. They took her to a doctor who said that the protruding surface was the bladder. When she was three years old a plastic operation was performed, which in part covered the raw surface but did not effect the continuous flow of urine.

Physical examination showed well formed labia majora with the scar of the old operation at the upper junction (fig. 1). There was a separation of the pubic bones but no absence of the abdominal or bladder wall above (fig. 2). However, as a plastic skin (fig. 1) had been made which, as her father stated, covered much of the raw surface, I could not determine the exact extent of the original deformity. The vaginal orifice was the opening of what appeared to be a large urethral fistula, through which urine trickled continuously. Into this a finger could be inserted and no sphincter muscle could be detected. The thin skin flap could be felt above.

The patient, who had accepted her incontinence as a matter of course and supposed it was an unalterable condition, was told that the hernia was of lesser importance and that the condition of incontinence could be corrected by an operation. As she had had an operation without relief she would not consent to another unless she could be assured that it would result in her being able to keep dry. When we told her that our advice was based upon the successful end-results secured in 15 cases of transplantations of the ureters, she gladly consented.

The ureters were transplanted at separate operations two weeks apart—the right into the rectum and the left into the sigmoid by the method devised by Coffey (11) and previously described by me (12). By this method, which is in effect, "physiological" implantation of the ureters wherein their course underneath the mucous membrane of the gut corresponds to the normal course of the ureters through the wall of the bladder, their physiological function is maintained.

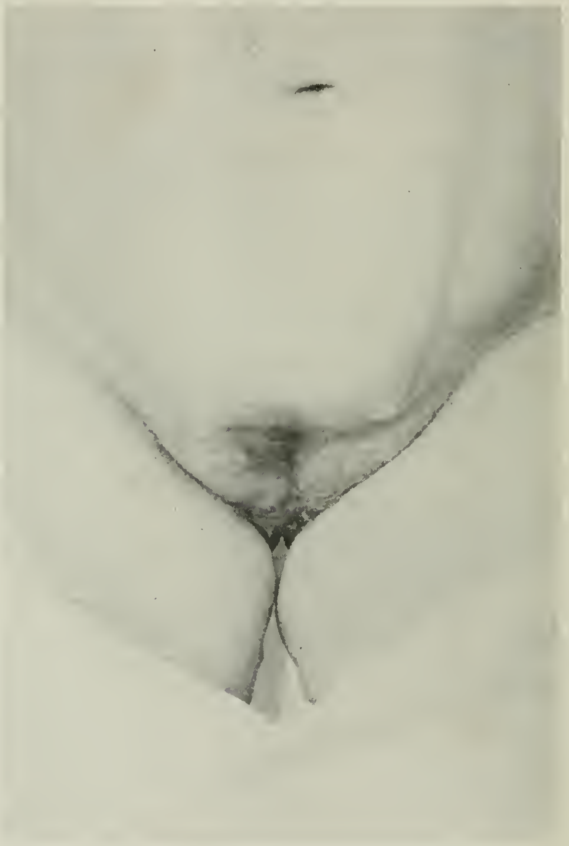

Fig. 1. Epispadias in a Woman

Author's case; external appearance showing scar; plastic operation

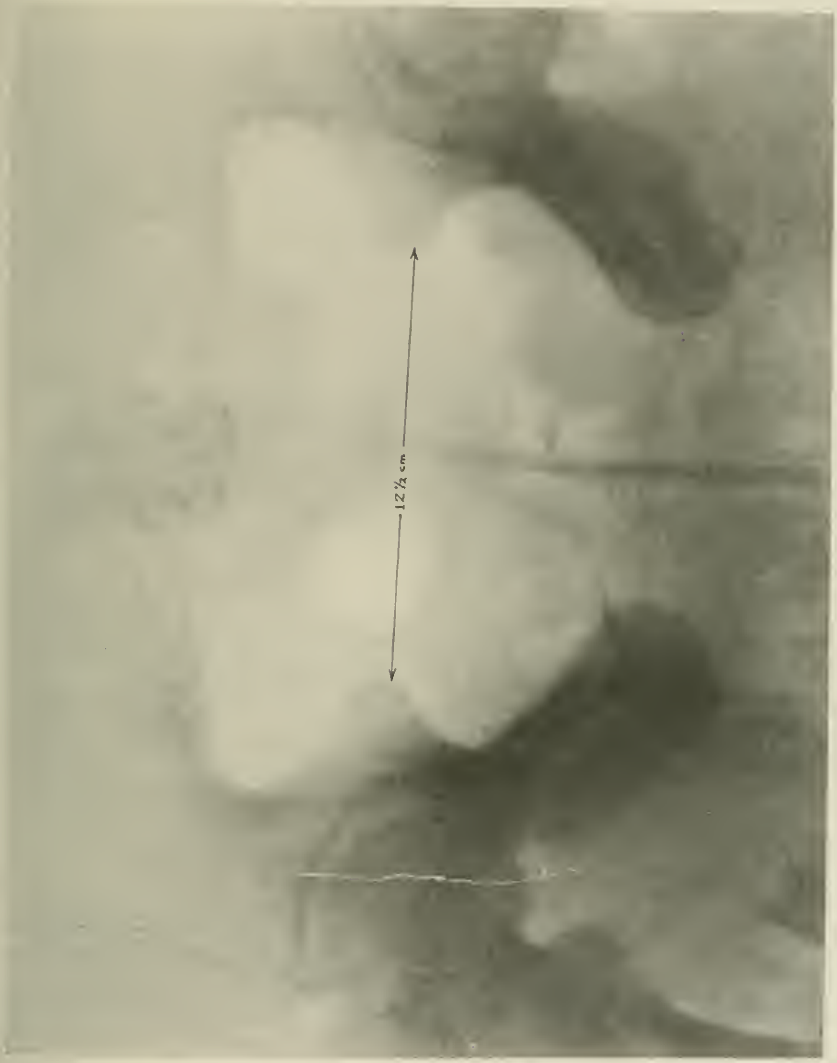

Fig. 2. Epispadias in a Woman

Author's case; Roentgenogram showing separation of the pubic bones

The second operation was performed on November 14, 1921, at which time her hernia was corrected. A little less than two months later, on January 5, 1922, the patient reported that she was often able to get through the night without a bowel movement, and that during the day she had retention for seven hours. On March 24, 1922, four months after the transplantation of the ureters, the patient again reported in excellent condition, stating that she scarcely ever had to get up at night. The change in her mental state was most striking; as she put it "I have lived in a very different world since my operation." One month later, on April 27, she again reported, by request. She is almost exuberantly happy and looks the picture of health and contentment.

Of particular interest was the presence of Sir Harold Stiles at the first transplantation. He immediately suggested the probability that this was a case of epispadias rather than an exstrophy and further examination convinced us that it should be so classified. It was at this time that he made the further report of one of his cases, which we have mentioned above.

SUMMARY

True epispadias in the female is an exceedingly rare condition though it may be more common than we have believed.

We would classify as epispadias any type of defect of the dorsal wall of the urethra provided the bladder walls are intact.

Most plastic operations accomplish little more than a covering of the exposed parts.

Transplantation of the ureters into the large intestine ensures relief from incontinence.

The transplantation of each ureter should be done at a separate operation to avoid the possibility of a temporary suppression of urine and to diminish the postoperative reaction.

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REPORT OF CASES OF MALIGNANT GROWTHS OF THE BLADDER TREATED BY RESECTION AND RADIUM[1]

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Received for publication August 10, 1922

With the discovery by Beer that benign papillomata could be destroyed by fulguration, it was hoped that malignant growths could be eliminated by the same or similar methods, the dealing with such tumors by surgery alone having been unsatisfactory in many cases.

Fulguration proved to be of little benefit and often a menace in dealing with malignant tumors of the bladder. It caused slight destruction of tissue in some cases, stimulated others in their growth, and led to infection, while valuable time was lost to other methods, which might have proved beneficial.

Diathermy and x-rays were given a trial, with slight success, and were abandoned, to be resurrected again during the past few years, the latter in the form of more powerful machines with deeper penetration. This work is still highly experimental. We will await clinical reports with interest and hope.

Radium was taken up as an agent of destruction of malignant bladder tumors. It was first applied, through variously modified cystoscopes, directly to the tumor. In but few cases was this method of treatment satisfactory. We were not sure of the pathology or extent of the growth we were treating. The application was on the surface, was of short duration, and caused discomfort at the time of application. Bladder irritability was often increased. These cases, however, showed that there was some effect upon the tumor which was beneficial.

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

In glancing over the report of Gardner (1), a collection of 1702 cases of bladder tumor treated by operation at the hands of various surgeons, one is impressed with the almost uniformly fatal results within from one to two years in cases treated by operation only.

A combination of radium and surgery was the next step, and the question now before us is just how valuable an accessory to surgery radium will prove to be in these cases.

In my own experience of the past two years, embracing but 19 cases, all treated by suprapubic cystotomy—in 2, the extensive infiltrating carcinoma largely destroyed by actual cautery and the base treated with radium; others treated by resection only; several by radium without resection, and the majority by resection and radium—certain points have been impressed upon me which seem worthy of report.

Of these 19 patients, 14 were males, 5 females. Their ages were forty to fifty, 4; fifty to sixty, 7; sixty to seventy, 5; seventy to eighty, 2; eighty to ninety, 1.

All of the patients had hematuria, the duration of which varied from two weeks to two years. They were free from urinary symptoms—urgency, frequency, painful urination—or these symptoms were distressing.

But 2 patients had maintained their weight; the others had lost from 5 to 25 pounds, the average being a loss of 15 pounds in six months.

Six of the cases presented a papillomatous growth; 13 an infiltrating growth, unquestionably cancer from the cystoscopic picture. In 4 of the papillomatous growths, where a possibility of its being benign was entertained, fulguration was first attempted, in each case the growth showing no response. All of the 19 cases proved to be malignant.

The test of fulguration upon a papilloma is often valuable in establishing a diagnosis. If a papilloma does not respond to fulguration at once it is probably malignant, and the bladder should be opened without delay. The histological study of the pathology of the growths has been interesting. Where doubt existed as to the nature of the growth removed, or sections taken

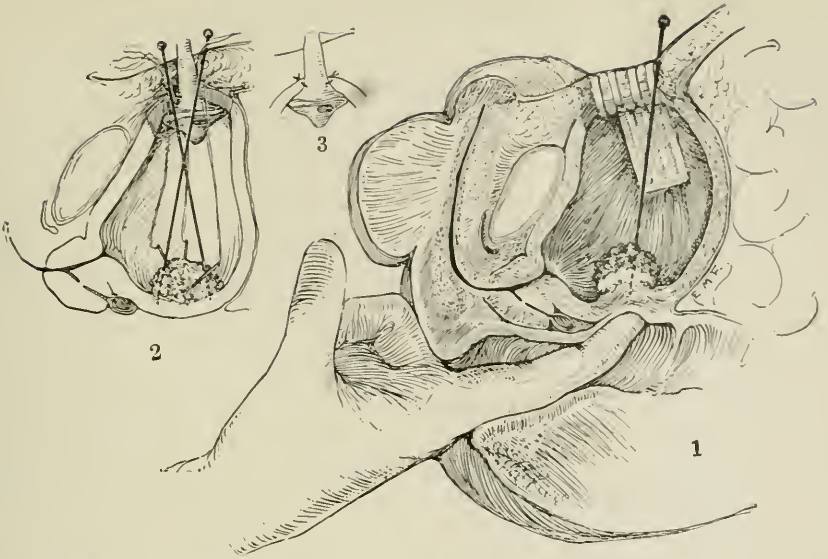

Fig. 1. Method of Introducing Radium Needles into Bladder Growth through Suprapubic Opening

Fig. 2. Radium Needles in Position
Wound closed about drainage tube

Fig. 3. Drainage Tube Sutured in Position to Prevent Displacement upon Withdrawal of Radium Needles

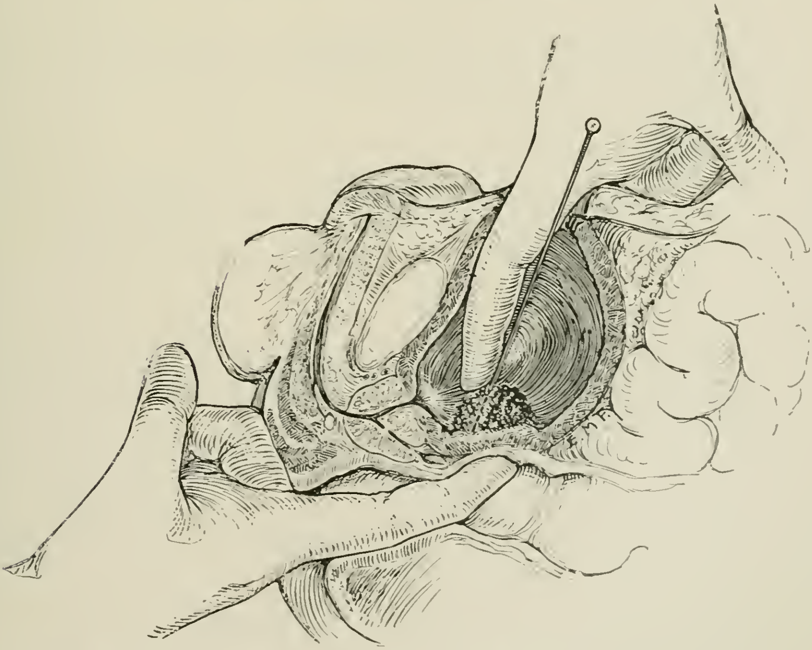

Fig. 4. Method of Reintroduction of Radium Needles through Suprapubic Fistula

NUMBER	PATIENT	DATE	SEX	AGE	SYMPTOMS	HEMATURIA	LOSS OF WEIGHT	CLASSIFICATION OF TUMO
							pounds	
1	A. C.	4/20/20	M.	41	Frequency, urgency, painful urination for 9 months	9 months	15	Diffuse, infiltratin carcinoma involv ing base and ves ical neck
2	H. L.	7/1/20	F.	52	Frequency of urination	7 months	18	Infiltrating carcin oma of fundus o bladder
3	J. K.	7/1/20	M.	51	Frequency, urgency, painful urination for 7 months	7 months	10	Infiltrating carcin oma of bladde wall about blad der neck
4	J. M.	7/12/20	M.	63	Frequency of urination	2 months	18	Infiltrating carcin oma of anterio bladder wall
5	A. S.	9/7/20	M.	68	Frequency of urination	2 weeks	5	Papillary growth i fundus of bladde
6	F. B.	9/13/20	M.	44	Frequent painful urination for 2 years	2 years	20	Diffuse infiltrating carcinoma of base and vesical neck

OPERATION	RADIUM	SPECIMEN	RESULTS
Suprapubic cystotomy. Destruction of growth to serous coat of bladder with cautery	100 mil. applied to base of growth through suprapubic wound for 6000 mil. hours. Endovesical applications for 450 mil. hours. Per rectum 600 mil. hours	Carcinoma	Wound healed. Died of general metastasis 9 months after operation
Vide resection of bladder	None	Carcinoma	Wound healed. Free for 4 months. Recurrence extensive. General metastasis. Died 7 months later
uprapubic cystotomy. Radium. Second suprapubic cystotomy 10 months later	Radium needles inserted into 4 nodules, 12½ mil. each. Endovesical applications, also rectal applications. Needles again inserted into recurrences at second operation	Adenocarcinoma	Wound healed. Bladder irritability persisted. 4 months after second operation general metastasis. Died
Vide resection of bladder wall	Radium packs, 400 mil. for 24 hours, 3 packs	Carcinoma	Wound healed readily. Implant in scar disappeared after first pack. Well. Free from recurrence. Patient well, 3/15/22
No response to fulguration. Resection of bladder. Radium needles	3 needles about line of resection of pedicle, 3 hours	Early malignancy	Wound healed readily. Free from recurrence today. Patient well, 3/15/22
Suprapubic cystotomy. Destruction of growth to serous coat of the bladder with cautery	Radium applied to base of growth through suprapubic wound, endovesically, and per rectum, 4800 mil. hours, 600 mil. hours, 800 mil. hours, respectively	Carcinoma	Wound healed. Bladder irritability persisted. Recurrence in bladder. General metastasis and death in 9 months

NUMBER	PATIENT	DATE	SEX	AGE	SYMPTOMS	HEMATURIA	LOSS OF WEIGHT	CLASSIFICATION OF TUMOR
							pounds	
7	A. R.	9/24/20	F.	54	Frequency, urgency, for 3 months. Cancer of breast removed five years previously	3 months	10	Infiltrating carcinoma of fundus of bladder
8	G. M.	12/29/20	M.	56	Urgent, frequent, painful urination for 2 years	Intermittent for 8 months	5	Infiltrating carcinoma of base of bladder and trigone. Individual nodules
9	G. S.	1/ 1/21	M.	84	Frequency for 1 year	1 year	15	Infiltrating carcinoma of base of bladder
10	H. S.	1/24/21	M.	74	Frequency and urgency for 2 years	2 years	25	Infiltrating carcinoma of entire bladder base and right lateral wall
11	J. D.	7/10/21	M.	50	Frequency, urgency	1 year	15	Papillary growth infiltrating bladder about vesical neck and involving left lateral wall

OPERATION	RADIUM	SPECIMEN	RESULTS
uprapubic cystotomy. Radium	3 radium needles, 12½ mil. each, inserted into growth (4 hours). Nodule, 1½ cm. in diameter, after surface applications through cystoscope. 5/17/21, reappeared and needles inserted (4 hours)	No section removed. Typical infiltrating cancer	2/19/22. Bladder reopened for supposed recurrence. Incrustation found at site of former growth. Bladder free of growth. Patient well, 3/15/22
uprapubic cystotomy. Radium	10 radium needles, 2 of 25 mil., 4 of 12½ mil., and 4 of 10 mil., each inserted into nodules (4 hours). Recurrence, bladder reopened and 4 needles inserted into nodules (3 hours)	Carcinoma	Wound healed. Bladder irritability persisted. Recurrence. Bladder reopened one year later. General metastasis
uprapubic cystotomy. Radium	3 radium needles, 12½ mil. each, inserted into growth. Repeated one month later (4 hours). On three repeated examinations no growth visible or palpable	Carcinoma	Patient died of pneumonia 1 year later. Bladder removed and found free of growth. 2/15/22
uprapubic cystotomy. Radium	8 radium needles inserted into bladder base (6 hours), 2 of 25 mil., 4 of 12½ mil., 2 of 10 mil. 4 needles inserted through suprapubic wound, 1 month apart for 3 applications; 3 needles for 2 applications 2 months apart, and 1 of 2 needles	Carcinoma	No hard growth palpable. Bladder base edematous. Wound healed. Partial incontinence. 3/15/22
uprapubic cystotomy. Radium	12 radium needles inserted, 2 of 25 mil., 4 of 12½ mil., 2 of 7 mil., for 6 hours	Adenocarcinoma	Wound healed. Free from growth by inspection and intravesical palpation 6 months later. Patient well. Free from growth. 4/19/22

NUMBER	PATIENT	DATE	SEX	AGE	SYMPTOMS	HEMATURIA	LOSS OF WEIGHT	CLASSIFICATION OF TUMOR
							pounds	
12	S. S.	7/26/21	M.	74	Frequency, urgency	2 years	10	Large infiltrated carcinoma of left lateral wall and base of bladder
13	D. R.	7/26/21	M.	44	Frequency	9 months	5	Papilloma attached to trigone close to right ureter
14	S. D.	9/12/21	F.	61	None	9 months	10	Malignant papilloma
15	E. R.	9/17/21	F.	58	None	7 months	None	Infiltrating carcinoma
16	J. W.	11/11/21	M.	65	Frequency	2 weeks	None	Malignant papilloma
17	M. Y.	1/27/22	M.	48	Frequency, urgency	15 months	5	Malignant papilloma
18	C. R.	1/31/22	M.	52	Frequency, urgency	2 years	10	Infiltrating carcinoma, entire base
19	S. O.	2/10/22	F.	63	Frequency, urgency	15 months	15	Infiltrating carcinoma, extensive, 2 growths

OPERATION	RADIUM	SPECIMEN	RESULTS
prapubic cystotomy. Radium	10 radium needles inserted, 2 of 25 mil., 4 of 12½ mil., and 4 of 10 mil., for 6 hours	Carcinoma	Bladder free of growth. Patient well. Wound healed. 4/15/22
sical papilloma responded at once to fulguration. Suprapubic cystotomy 9 months later	2 radium needles of 25 mil. inserted through bladder base into perivesical growth	Carcinoma	Treated by fulguration 4/9/21. Rapid disappearance of growth. Occlusion of right ureter. Right nephrectomy. Suprapubic cystotomy. No bladder growth. Rapid perivesical growth of carcinoma and death from metastasis
response to fulguration. Resection of bladder. Radium	4 radium needles, 10 mil. each, inserted about line of resection for 4 hours	Early malignancy	Wound healed. No recurrence to date. Slough in needle wounds for 3 months. Patient well, free of growth 4/18/22
esection of bladder. Radium	4 radium needles of 12½ mil. each, inserted about line of resection of growth for 5 hours	Carcinoma	Wound healed. No recurrence to date. Slough in needle wounds for 4 months. Free of growth 3/16/22
esection of bladder. Radium	3 radium needles of 10 mil. each inserted about line of resection for 4 hours	Carcinoma	Wound healed. No recurrence to date, 4/10/22
o response to fulguration. Resection of bladder. Radium	4 radium needles of 10 mil. each inserted about line of resection for 3 hours	Early malignancy	Wound healed. No recurrence. Sloughs about needle wounds still present (3 months) 4/16/22
prapubic cystotomy. Radium	6 radium needles, 1 of 25 mil., 2 of 12½ mil., and 3 of 10 mil., inserted into the growths	Carcinoma	Drainage tube in position. Growths markedly diminished in size, 4/10/22
prapubic cystotomy. Radium	8 radium needles, 2 of 12½ mil., 4 of 10 mil., and 2 of 7 mil., inserted into the two infiltrating growths	Carcinoma	Drainage tube in position. Growths diminishing rapidly 4/19/22

for diagnosis, the same section or sections from different parts of the growth have been submitted to more than one pathologist. In several instances one pathologist has reported no malignancy while another, in the same case, has reported carcinoma. This means either a different classification of bladder tumors by individual pathologists, or malignancy in isolated areas of the growth.

The accompanying chart gives the important points in these cases.

TO SUMMARIZE THESE CASES

The 2 cases treated by suprapubic cystotomy, actual cautery destruction of growth, and radium (cases 1 and 6) were hopeless cases from the start. The growth was very extensive, and there were signs of metastasis. Both men were young, forty-one and forty-four years of age, and it was an attempt to do something for their relief, the symptoms being most distressing.

The female with the infiltrating carcinoma (case 2) of the fundus of the bladder, was in perfect health for four months after operation when, within three weeks' time, a very extensive recurrence appeared in the bladder and abdominal scar, although the resection had been a wide one, with 2 cm. of healthy bladder on every side of the growth. She rapidly developed metastasis.

Case 3 presented small indurated nodules which proved to be adenocarcinoma. Although the nodules disappeared readily under the radium, others appeared and the growth metastasized rapidly.

Case 13 was a benign papilloma with a malignant base. The intravesical portion of the growth disappeared rapidly under fulguration, while the base extended along the outer bladder wall, completely surrounding the bladder, occluding the right ureter, and appearing in the anterior abdominal wall. Metastases developed rapidly.

In case 4, the growth, a large infiltrating cancer of the anterior bladder wall, was eliminated by resection and the implant destroyed readily by radium pack.

In cases 7, 9, 10, 11 and 12, of infiltrating carcinoma, the bladder was freed of growth by destroying the growth with radium needles, in the first 3, repeated introductions being necessary. In cases 18 and 19, recent cases, the growths are rapidly receding.

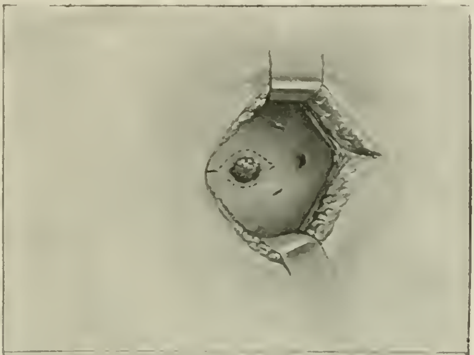
Fig. 5

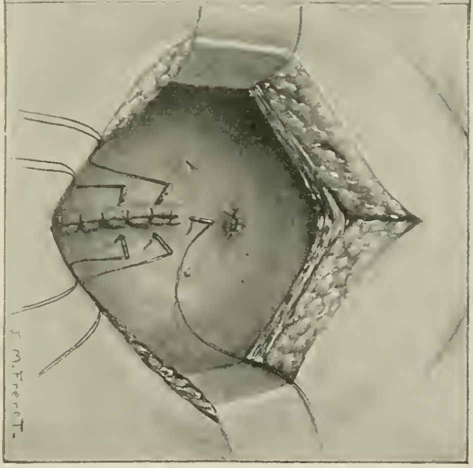
Fig. 6

Fig. 5. Case 15. Carcinoma of the Base of Bladder

Fig. 6. Case 15. Radium Needles Inserted about Line of Resection

In case 8, isolated infiltrating growths recurred and metastases have been present for one year.

In case 15, infiltrating carcinoma treated by resection and radium, needles being inserted about the line of suture, the bladder has been free of recurrence for seven months. The histological sections in this case showed a rapidly growing carcinoma, strains of cancer cells extending along the muscle bundles.

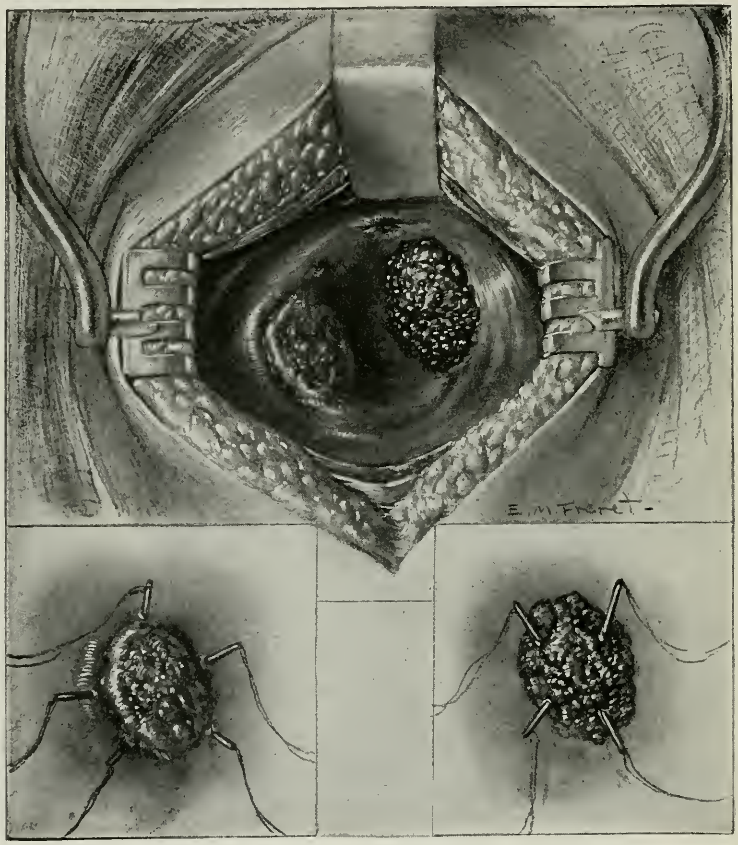

Fig. 7. Case 19. Two Infiltrating Growths of Bladder Base
Insert shows radium needles in position

In cases 5, 14, 16 and 17, malignant papillomata, resection supplemented by radium needles about the line of resection, has given in each case a bladder free of growth to date.

SUMMARY

In cases of extensive carcinoma of the bladder, when metastasis has taken place, one's effort should be directed toward making the patient as comfortable as possible. Often this may best be attained by simple bladder drainage.

In extensive carcinoma of the bladder without metastasis, in lieu of total or subtotal cystectomy, it is possible in some cases to destroy the growth by repeated insertions of radium needles—*if* one bears in mind that he is trying to destroy the growth, not the patient, *by not too massive* a dose, but by repeated insertions at sufficient intervals, giving free bladder drainage to allow for sloughing and infection, every effort being exerted during the process to increase body elimination.

A circumscribed carcinoma should be removed by resection, if possible. Recurrences after operation are less resistant than the primary growth, sometimes yielding even to fulguration. A careful watch of all cases following operation, should be maintained that recurrences may be detected as early as possible, and destroyed, thus minimizing the chances of metastasis.

The insertion of radium needles into the bladder wall about the line of resection causes the formation of sloughs which have in some cases remained for four months. Such a procedure is valuable in minimizing the chances of local recurrence by destroying stray cancer cells and involves no risk or discomfort.

Malignant papillomata should be removed by resection, the line of resection being fortified by the insertion of radium needles.

While the cases reported are too recent to warrant the drawing of conclusions, the course of these cases so treated has been decidedly more satisfactory than in those treated by methods formerly employed.

REFERENCE

(1) Gardner: Trans. Amer. Urol. Assoc., 1915.

FOOD ALLERGY AS A CAUSE OF IRRITABLE BLADDER[1]

W. W. DUKE

Kansas City, Missouri

Received for publication, November 4, 1922

In a relatively large proportion of patients with frequent painful micturition the severity of the illness seems out of all proportion to lesions found on careful examination by specialists and in spite of symptoms suggestive of cystitis the urine may be free of both bacteria and pus. The usual remedies for bladder disorder often fail to relieve in this type of illness and severe symptoms may persist for months almost without remission.

Bladder disorder in patients of this sort is very often the result I believe of hypersensitiveness to foods. Specific hypersensitiveness (often discussed under the terms anaphylaxis and allergy) has been recognized as the underlying cause of hayfever, asthma, urticaria, angioneurotic edema, and certain types of gastrointestinal upset for a number of years. The circumstance that bladder pain can be caused by food has been recognized both by physicians and laymen. The impression has been gained, however, that such pain has been due to an acid or crystalized substance in the food and this in spite of the fact that other acids such as vinegar and other foods rich in crystaloids produce no such result. The suggestion that hypersensitiveness to food is rather frequently a cause of bladder disorder should not, therefore, seem unreasonable.

In a previous paper I reported 3 cases which appeared to be clear examples of individuals who had frequent painful urination as a result of the ingestion of certain foods to which they were proved hypersensitive and in whom no other pathology could be found after a careful examination by internists, urologists roentgenologists, and pathologists. I also reported 2 cases in which slight local pathology was found which did not seem adequate to account for the severity of the symptoms complained of. Since the publication of this paper I have observed other cases of a similar nature.

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[1] For a detailed report of this condition, see Annals of Clinical Medicine, i, no. 2, 117.

The patients gave a history of attacks of frequent painful urination which in several cases lasted only a week or so and in others lasted for months. In 1 case the symptoms extended almost continuously over a period of several years and for weeks at a time confined her to bed. Intracutaneous tests in each case showed the patients to be sensitive to one or more foods which they were in the habit of eating and when such foods were eliminated from the diet the symptoms in the uncomplicated cases disappeared immediately and completely. Recurrence of the bladder symptoms were brought on again in several cases by the feeding of foods to which the patients were sensitive and by the subcutaneous injection of extracts of such foods.

The mucous membrane of the bladder does not under ordinary circumstances come in direct contact with substances to which it is sensitive as does the skin and the mucous membrane of the respiratory and gastrointestinal tract. Bladder reactions could occur theoretically therefore only as part of a general reaction after the offending substance enters the body through some distant portal and would be analogous to a rash or angioneurotic edema caused by the ingestion of egg rather than to hayfever or asthma caused by local contact of the mucous membranes with pollen.

Bladder reactions of this sort (or bladder allergy) have seemed to me to be very real and a relatively common clinical condition and I believe accounts for many cases of severe bladder disorder of undetermined origin.

REPORT OF A CASE OF SCHISTOSOMUM HEMATOBIUM[1]

JAMES PEDERSEN

New York

Received for publication August 10, 1922

The patient, a boy seventeen years old, was born in Africa. When three years old he came to the United States with his parents. The family returned to South Africa a year or two later and lived there until the boy was ten years old, at which time they again took up their residence here.

For seven years, i.e., ever since his second stay in South Africa, the boy had had intermittent hematuria. The degree had varied considerably; clots had occasionally been seen recently. There had been no disturbance of the bladder function and no pain, at any time. The patient had had no symptom except hematuria. We found him well developed for his age; neither inconvenienced nor alarmed by the hematuria. He had grown up with it.

The cystoscopic examination showed several small areas of a dull red color; they looked like hemorrhagic blotches, slightly raised above the surface of the mucous membrane. More or less surrounding these areas, irregularly scattered, were small elevated points, like vesicles (fig. 1).

The picture suggested tuberculosis, though the absence of both pain and frequency of urination made that diagnosis impossible. The Wassermann test was reported positive 2+ by one laboratory; negative by two, five days later. Repeated examinations of the urine proved the absence of tubercle bacilli; but there were marked traces of albumen, occasional red cells, a few single leucocytes, a normal amount of mucus and an ob-

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

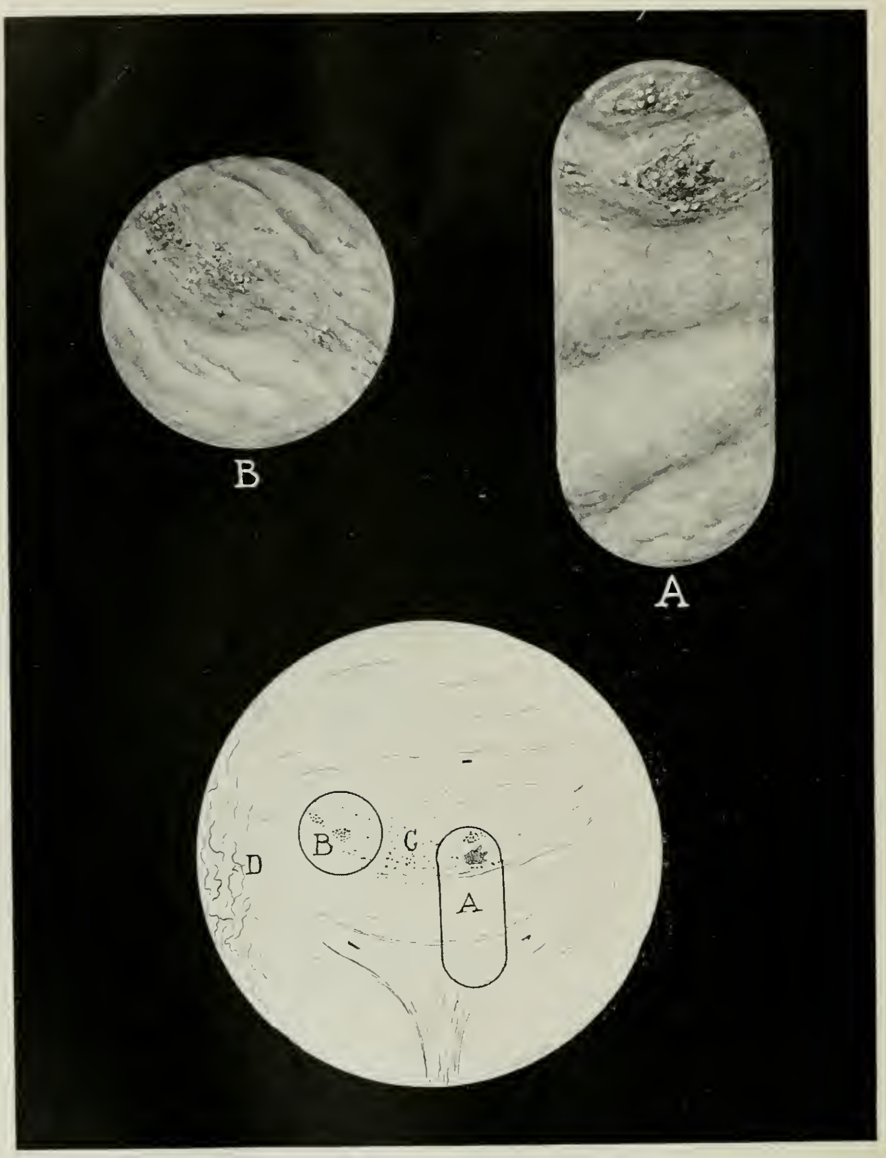

Fig. 1. The cystoscopic view of the lesions is shown in the drawings A and B. Their respective location in the bladder is indicated in the diagram. At C were scattered vesicles. At D a roughening of the mucous membrane.

ject which was identified as the ovum of the Schistosomum hematobium. These ova were fairly numerous. A few were found in the feces.

The regulation treatment was given—a normal salt solution of tartar emetic intravenously every other day for a period of three weeks, during which time he was kept in the hospital. Thereafter he was treated every third or fourth day in the office and allowed to return home. The commencing dose was 0.5 grain; the maximum reached was 2.75 grains.

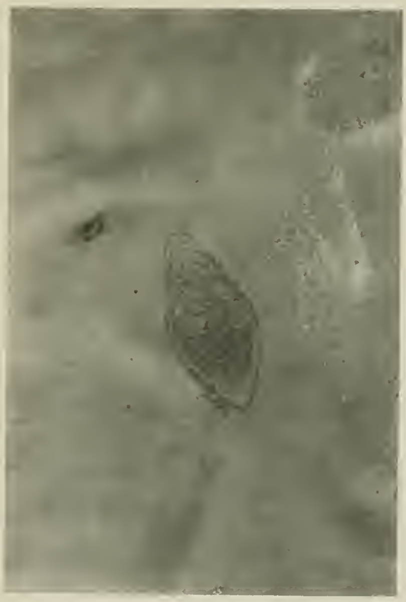

FIG. 2. MICROPHOTOGRAPH OF AN OVUM

The only reaction was a very transient nausea until on one occasion during the office course, when the maximum dose (2.75 grams) was given and repeated two days later. Marked nausea and depression, embarrassed respiration and slowing of the pulse to 60 promptly occurred. After resting for nearly three hours, he was able to go home comfortably.

The patient received in all 25 injections over a period of two months and a half. The ova began to disappear with the twelfth injection. None had been found for a month before he went away to college. A specimen of urine submitted six weeks after treatment had been necessarily stopped, was equally free from them. Eight months have elapsed and no relapse has been noted.

Cases of this disease are rare in our climate. In October, 1918, Dr. McCarthy and Dr. Maximilian Stern reported a case from the Urologic Service at the Post Graduate Hospital. The patient had contracted the disease in Egypt while working in an irrigating ditch. He developed hematuria very soon after exposure, and hurriedly returned to the United States. The cystoscope showed clusters of whitish pinhead elevations with a red areola. Some of these elevations were more prominent and spheroidal as if about to rupture. On the posterior wall there were carinoma-like formations, ragged and red; one, which was pedunculated, was spherical in shape and the size of a hazel nut.

The trifling symptoms and lesions in the seventeen year old boy with a seven year history when contrasted with the symptoms and grosser lesions in the older subject whose history was brief, naturally raise three questions: (1) as to the influence of age; (2) as to a variation in the virulence of the organism; (3) as to whether bilharziosis is a factor in vesical new growths.

On questions (1) and (2) we may speculate. On (3) we have this interesting testimony in the literature. Ferguson (Journal of Pathology and Bacteriology, 1911) discussing bilharziosis associated with primary malignant disease of the bladder, reports 40 cases of that description examined by him during his six years in Cairo. All were male subjects whose ages averaged forty-two. The outstanding points are these: (1) At least 40 per cent of all males over five years of age in the agricultural population in Egypt, have bilharziosis (urinary bilharziosis). (2) Malignant disease of the male bladder is more common in Egypt than in any other country. (3) Malignancy of the anus, rectum, sigmoid and colon is remarkably rare considering the fact that those parts are equally infected by the parasite.

Of the 40 cases (all came to autopsy), 34 proved to be flat cell epithelioma; the remaining 6 were sarcoma.

Ward, a zoölogist, writing in Wood's Handbook, describes three varieties of the schistosomum which produce severe disease in man, and notes that they have been more or less confused.

Only one produces bladder lesions, namely, the Schistosomum hematobium. It is native, apparently, only in Africa and the contiguous parts of Asia; it occurs elsewhere only when imported. The parasite, however introduced, gains the portal vein and works against the current until it lays its eggs in narrow venules in the submucosa of the bladder, thus blocking the venules. It is not known how the ova escape from the veins of the submucosa to form the bladder lesions.

Ova or embryos may be carried along in the current of these small venules, reach the vena cava and get into the general circulation. Their distribution is then very like that of the tubercle bacillus—lungs, liver, peritoneum, etc.

When the ova escape into the mucosa of the bladder from the submucous venules, they cause inflammation and swelling of the mucosa, followed sometimes by hypertrophy and the deposition of mineral matter, thus giving rise to hard, circular areas and sandy patches. Phosphatic stone may result. Stone develops in 80 per cent of Egyptian cases, the ova forming the nucleus. Papillomata occur, variable in size, often occupying a large surface.

Pain is felt in the lumbar region and blood and pus are expelled with the urine in these advanced cases. The symptoms progress in severity. The disease, known by the generic name bilharziosis, is persistent and may last six, eight or more years. If the patient is continually exposed to infection, successive exacerbations occur.

The second form, the schistosomum of Manson, has a different geographical distribution; it is common in the West Indies and South America and sometimes occurs in our southern states. It is found, of course, in Egypt and other parts of Africa. By itself it does not produce bladder lesions, but when associated with the Schistosomum hematobium, causes a severe form of bilharziosis.

The third or Japanese form of schistosoma, indigenous in Eastern Asia, is the cause of a serious and often fatal form of disease; but spares the bladder. The Public Health Service is alert to keep it out of the United States.

The mistake of grouping the diseases set up by these trematode parasites under the term ''bilharziosis'' is responsible for much confusion. The term bilharziosis should be restricted to the variety that attacks the bladder. Of this, there are two clinical forms, one is medical and curable by emetine and antimony; the other is surgical throughout. The medical type is simple bilharzial hematuria, the so-called uninfected type with plenty of ova in the urine. Physicians who report these cases never use the cystoscope so that no one knows whether lesions are present in the bladder or not. The vesical symptom is irritability. The cure may be temporary or there may be only a spontaneous intermission. These cases may or may not become infected and border on a surgical form. It is evident that the purely surgical case with its multiple tumors and infection is not amenable to drugs; but whether this is a separate variety from the start, or a later stage of the medical case, does not seem to be clear.

Pavy (Medical Journal of Australia, August 27, 1921) reports 10 cases treated only with intravenous injections of tartar emetic. The average total amount given was 27 grains during the course of from seven to eight weeks. The ova disappeared from the urine in from three to four weeks. The toxic symptoms were cough, nausea and vomiting. In fact, a paroxysmal cough seems to have occurred regularly, beginning a minute after the puncture and lasting five minutes. There was also pain and stiffness of the arm and shoulder muscles for some hours after the injection. Loss of appetite and consequent loss of weight together with general malaise were noted. Like Casper, he puts pyuria and hematuria on a par in the symptomatology.

REPORT OF A CASE OF TRUE HOUR-GLASS BLADDER[1]

HERMAN L. KRETSCHMER AND HAROLD L. MORRIS
Chicago, Illinois

Received for publication May 10, 1922

The term hour-glass bladder has been used more or less indiscriminately in describing certain types of bladder pathology. A somewhat brief review of the literature reveals the fact that cases have been reported as hour-glass bladders that in reality should have been reported as cases of diverticulae. The presence of a large diverticulum and its attachment to the bladder occasionally results in the formation of an hour-glass "arrangement." It seems to us that this is an erroneous description of the pathology and such a case should more properly be designated as a case of diverticulum.

Cases of true hour-glass bladder are exceedingly rare as evidenced by the scarcity of case reports in the literature and it is for this reason that we wish to briefly present for your consideration a case of true hour-glass bladder.

Hour-glass bladders have been divided into two groups, depending upon the location of the constriction which results in the hour-glass formation. To one group belong the cases in which the ureters are in the upper part of the bladder, or the ureteral openings lie above the constriction. In group two are included the cases in which the ureters are in the lower bladder cavity. The cases of Fuller, Detwiler and Cutter belong to the first group while in the second group may be placed the cases of Fothergill, Passo and Caulk.

H. C., aged eighty-three. Personal and family history were negative. Patient's urinary symptoms dated back twelve years at which time he noticed burning on urination, frequency and difficulty in stopping the flow. Symptoms increased in severity with periods of remission until two months ago when he had difficulty in voiding and it became necessary to resort to the use of a catheter in order to empty the bladder.

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[1] Read before the Chicago Branch of the American Urological Society, October 13, 1921.

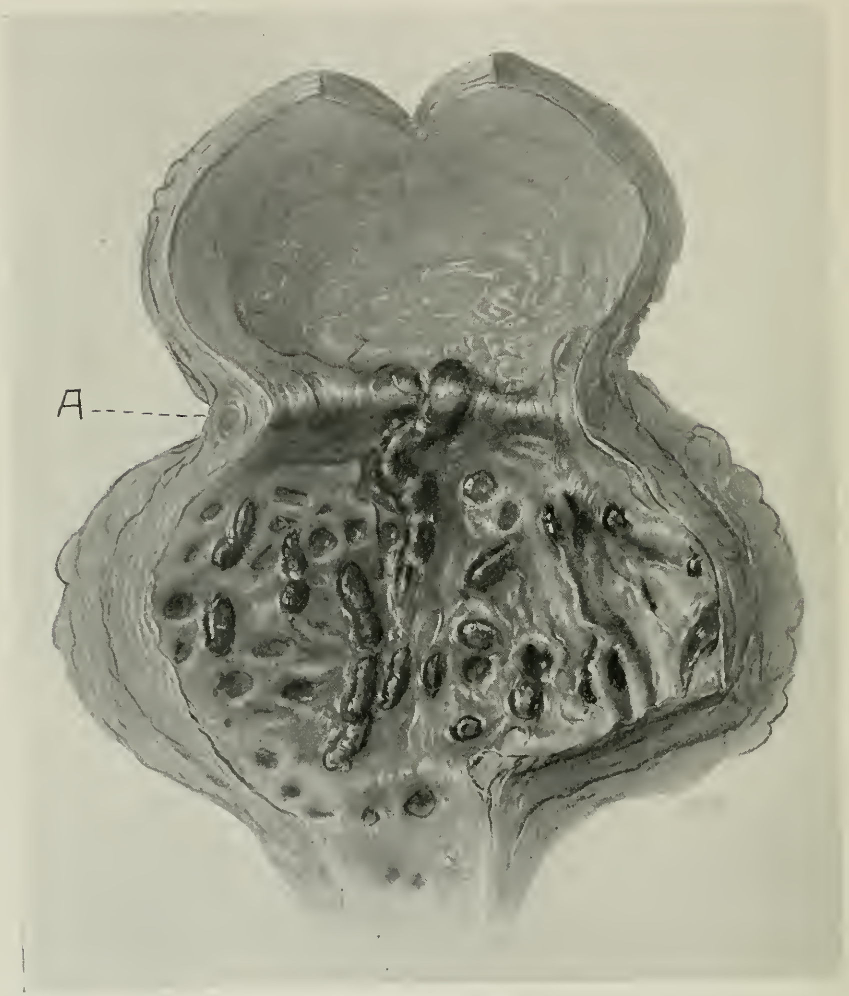

Fig. 1. Showing Presence of a Definite, Firm Constriction at "A" Resulting in the Production of Two Cavities

Patient entered the hospital with a soft rubber catheter in the bladder which had been in place about one week.

Patient was an old man, emaciated, and evidently in great pain and distress because of his distended bladder. The general physical examination was negative. Above the pubis there was a tumefaction due to a greatly distended bladder. A double direct inguinal hernia and the presence of a double hydrocele were noted. The urethra contained an indwelling catheter that was not performing its function. Rectal examination was negative.

Roentgen ray examination was negative.

Urinalysis showed albumin present; no sugar; and blood and pus present.

Cystoscopy was attempted but was unsuccessful because of profuse bladder hemorrhage and pain. Because of the patient's critical condition subsequent attempts to cystoscope him were not carried out.

Operation, November 21, 1920. Because of the critical condition of the patient it was decided to perform a suprapubic cystotomy for drainage. At operation the bladder wall was found very much thickened. After the bladder wall was opened, two bladder cavities were demonstrated. A firm contracture was plainly visible. There was no sign of intravesical protrusion of the prostate. A large rubber drain was inserted into the superior cavity and the usual closure in layers was made.

Result: Patient died eight days after operation.

It was with difficulty that consent for an autopsy was obtained and then permission was given to remove only the bladder itself. The bladder had two very distinct cavities with hypertrophy of the musculature, and ureteral orifices in the lower cavity (fig. 1). No evidence of prostatic tissue or carcinoma was found.

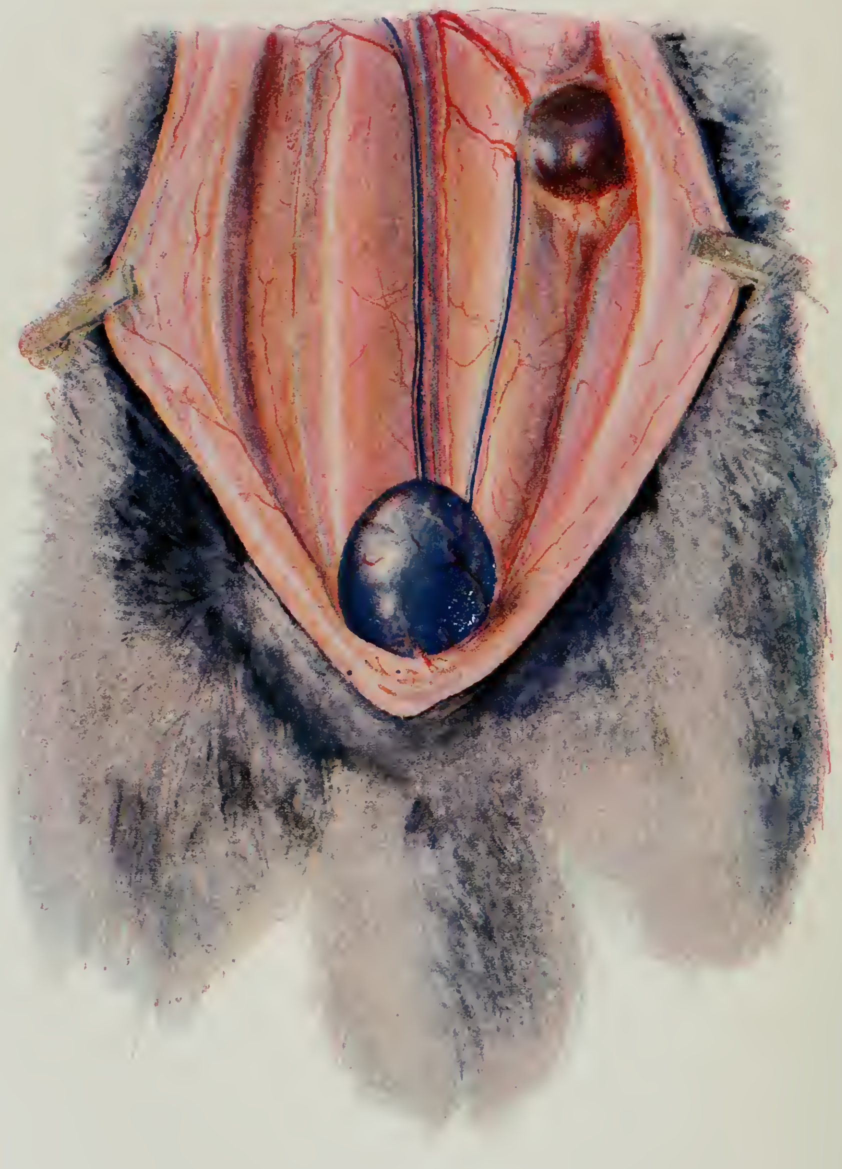

PLATE 1

Ureters Filled With Blue Fluid as a Result of Regurgitation of the Vesical Contents

STUDIES ON THE URETER AND BLADDER WITH ESPECIAL REFERENCE TO REGURGITATION OF THE VESICAL CONTENTS[1]

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INTRODUCTION

The controversy concerning the route by which bacteria reach the kidney in cases of renal infection has waged for many years. The early theory that all such diseases occur as a result of direct ascent of infectious material from the lower parts of the urinary tract has been denied in many later writings. Indeed it has given way to the view that these infections are blood-borne in every instance. The latter belief has been so firmly upheld in recent years that we have been led to feel, rather generally, that the ascent of infection along the ureter is a most remote possibility, if indeed it occurs at all. And there seems to be ample justification for this opinion. On the one hand there exists a paucity of evidence that ascending renal infections are clinical possibilities. On the other hand, we are confronted by definite experience and by indisputable facts concerning the kidney and its relation to bacteria carried by the blood stream. It has been repeatedly demonstrated, for example, that in general infections, viable microörganisms may be excreted by the kidneys without those organs presenting any evidence of local disease. It seems indeed to be an important renal function to aid in ridding the body of infectious material, and how far-reaching this rôle may be has as yet never been adequately determined. As has been

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[1] From the Laboratory of Surgical Research of the Harvard Medical School.

Read in abstract before the American Association of Genito-Urinary Surgeons, Cleveland, Ohio, May 17, 1923.

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said, with normal conditions in the urinary system the kidneys themselves do not suffer in this process. When, however, there is present for any reason—such as injury to the kidney or disturbance of its circulation—lowered resistance to infection, the picture becomes a very different one and the patient presents all the signs and symptoms of active renal disease. Probably of chief importance, in this regard, is interference with the normal outflow of urine, caused by obstruction, acute or chronic, at any level in the urinary tract. When there is stasis of urine and bacteria then are brought to the kidney, local infection becomes inevitable. In recalling these facts we are simply again reviewing that which has reached our attention many times and conspicuously through Quinby in recent publications.

Without further discussion, it may be said that we know, both from experimentation and abundant clinical experience, that hematogenous infections of the kidney occur and that they probably predominate. However, the attitude that the blood stream is the only route of invasion does not seem reasonable, in spite of the fact that concerning the alternative, there is no positive proof. All of us are familiar with cases which suggest most strongly an ascending infection; indeed there are instances in which no other explanation seems probable. The following clinical picture is often seen and may be cited as a single example:

> A patient whose bladder has previously been determined by cystoscopy to be normal as far as the ureteral orifices are concerned, has had a suprapubic prostatectomy performed. The convalescence has been uneventful and the temperature consistently normal. The suprapubic drainage tube has been removed. At the time when the sinus is almost completely closed and normal urination has not yet been well established, there suddenly occurs a chill followed by a rapid rise of temperature and all of the usual signs and symptoms of pyelitis.

This we have seen repeatedly and it is difficult to explain in any way other than that infectious material has been suddenly transported from the bladder to the kidney along the ureter.

Because of highly suggestive clinical evidence pointing toward ascending infection, and because the work on this subject has left many points undetermined, it has seemed to us worth while to undertake its more complete investigation. By ascending renal infection must be understood, of course, the passage of bacteria from the bladder to the kidney along the path of the ureter, either through its wall or by way of its lumen. Three types are conceivable.

1. Extension of infection upward along the ureteral wall through its lymph vessels. There is little evidence on anatomical grounds for such an occurrence, the lymphatics of the ureter being arranged segmentally instead of continuously from bladder to kidney; but even if anastomosis between the segments permits a continuous lymph stream, the considerable amount of experimental work doneon the subject has failed to prove, satisfactorily, that infection ascends along this channel.

2. Extension of infection along the lumen of the ureter through and against the column of descending urine. A passive ascent of this sort can only take place, obviously, in those cases in which disease of the ureter distorting the intravesical segment makes possible a free communication between bladder and renal pelvis. Such conditions exist, are fortunately not too common and need no further comment. In fact they should hardly be included as examples of ascending infection, in that the general disease of the urinary tract has long been present and the situation that we are describing is simply one of its results.

3. Extension of infection along the lumen of the ureter, anatomically intact, inwhich the bacteria are carried upward through the force of bladder regurgitation. It is this highly interesting possibility with which we are concerned, and we find that it has already been made the subject of a considerable amount of investigation.

Credit for the first efforts along these lines must be given to Semblinow who in 1883 determined with experimental animals that regurgitation of the vesical contents is possible under normal anatomical conditions. He produced reflux by mechanical stimulation of the ureter in a dog whose bladder had been filled with colored fluid. He believed that the phenomenon depended upon a combination of "various movements of the ureter and bladder" among them being ureteral antiperistalsis.

During the years between 1893 and 1898, Lewin and Goldschmidt started the first real study of reflux under conditions of normal anatomy. They used anesthetized rabbits, the bladders of which they distended with colored fluid through a urethral catheter. By these means they were able to produce regurgitation in a considerable number of attempts. They described two types of bladders—those which contracted firmly about the distending fluid and which usually produced regurgitation; and those which seemed incapable of vigorous contraction and which "never" gave reflux. "In spite of most intense observation" they were unable to determine any relationship between the phenomenon and the peristaltic activity of the ureter. Lewin and Goldschmidt were convinced that regurgitation was an established fact and that ascending infections might be explained upon that basis. They suggested as the factors necessary for its production:

1. Some influence acting to open the ureteral orifice (such as chemical change in the bladder and the impact of infected fluid).
2. A vacuum suction action of the ureter.
3. Bladder pressure.

They further interested themselves in the fate of particulate matter which had been carried to the kidney by the regurgitant stream, and demonstrated the ease with which this material gains access to the circulation and the distant organs, though they were unable to define accurately its route through the kidney. This ready communication "between the bladder and heart" was spectacularly demonstrated by cases in which they distended the bladder with air to the point of reflux and produced death of the animal by air embolism.

Courtade and Guyon in 1894 also began a study of regurgitation. Their methods were similar to those of Lewin and Goldschmidt except that they made use of a mercury manometer in order to measure accurately the intravesical pressure. In a series of 32 rabbits they produced regurgitation in 62.5 per cent of the cases. Using dogs, they were able to secure regurgitation in only 5 of 38 attempts (13 per cent). They ascribe the difference in results in the two kinds of animals to the stronger bladder musculature found in dogs. They attached great significance to the muscle bundles overlying the intravesical segment of the ureter in the dog, the cutting of which permitted reflux in some of their cases. They concluded that "when the bladder, endowed with sufficient tone, resists the distention in a precocious fashion, reflux is possible however small the quantity injected may be, as soon as the pressure produced by the tone of the bladder musculature reaches at least 15 mm. Hg in rabbits and 50 mm. in dogs." They believed that regurgitation was probably not impossible in humans, so far as experimental analogies could be permitted and that it probably could occur with the sudden tension produced by injection. They felt that it was not likely to happen in cases of retention because in their work they were unable to cause the phenomenon by artificially produced bladder contractions.

In a paper concerning the hydraulic distention of chronically infected, small contracted bladders, Dr. Young, in 1898, considered the possibility of reflux, and concluded that the normal ureteral valve and the oblique course of the ureter in the bladder wall afforded adequate protection against it. He stated that he had never produced ascending renal infection as a result of his method of forced distention of these diseased bladders. By way of experimental confirmation he filled to the limit of capacity the bladders of cadavers, and failed to obtain regurgitation. He was equally unsuccessful with two living dogs.

In 1903 Sampson in an admirable study considered the possibility of regurgitation particularly in ureters that had been freshly transplanted. He filled the bladders by means of a needle passed through the vesical wall and attempted thus to produce reflux. He concluded that "a reflux from the bladder into the normal ureter in dogs must be rather unusual if I have been unable to produce it at the time of operation, in 16 animals."

In the same year, Marcus, continuing the work of Lewin and Goldschmidt, had no difficulty in producing regurgitation in rabbits. He was chiefly interested, however, in the study of the distribution of particulate matter following reflux. He believed that the ready entrance into the circulation could be ascribed to minute ruptures in the renal pelvis with direct escape of the particles into the venous blood.

Wislocki and O'Conor (1920) secured regurgitation in 10 of 14 rabbits and in 1 of 3 dogs. Their conclusion of the mechanism of reflux was that "when the bladder is moderately distended and of good tone, the uretero-vesical sphincter is occasionally prevented from closing as it normally does after each gush of urine and the intravesical pressure projects a column of fluid into the ureter."

In addition to the experimental work above noted, Kretchmer, in 1916, made an exceedingly valuable clinical contribution to the problem. He observed in a study of the normal bladder by means of cystograms, as an incidental finding, that the ureters often filled with opaque solution. This regurgitation occurred 3 times in a series of 10 normal children under ether anesthesia. In one adult also, with a normal urinary tract as proved by cystoscopy, reflux was shown in the cystogram. During the examination the patient had a great desire to urinate, and Kretchmer believed the regurgitation to have been the result of increased tension through straining. Reflux was further shown to occur in 3 cases with disease of the vesical outlet (1, benign hypertrophy of the prostate; 2, contracture of the vesical neck; 3, tuberculosis of bladder, prostate and seminal vesicles) in which, however, cystoscopy had revealed what appeared to be normal ureteral orifices. In concluding the author stated: "It would seem that the increased intravesical pressure may be at least partly responsible in some of the cases for the occurrence of this phenonemon."

Further clinical evidence suggestive of reflux is found in the experiences of Pozzi, Modlinski, Israel, Alksne and probably many others. They described an outpouring of urine from the ureteral stump after nephrectomy and believed in each instance that the occurrence was the result of regurgitation.

These facts together with the repeated clinical phenomena which seem only to be explained on a basis of regurgitation have led the authors to believe that the subject warrants more comprehensive study than it has yet been given. In reviewing the situation we find that regurgitation of vesical contents has already been established as an experimental fact and as a clinical probability, but that little has been offered concerning the conditions under which it occurs and the factors which produce it. With the purpose to answer if possible some of these questions, the present work has been undertaken.

Our experimental material offered such favorable opportunities for observing the ureter in situ that we yielded to the temptation of studying this organ, the physiology of which is still incompletely understood.

ANATOMY

The anatomy of the ureter will first be reviewed to recall its essential features. Since fundamentally there are no differences in the higher species as far as this structure is concerned, the human ureter will be made the basis of our description.

The ureter is a hollow muscular organ which conveys urine from the kidney to the bladder. Protopopow gives the average length of each ureter as 25 to 30 cm. and the average thickness as 0.5 cm. It is of uniform caliber throughout, save for two points of narrowing which lie at the junction of the ureter with the pelvis and in the intravesical segment. It occupies an extraperitoneal position and extends from the renal pelvis downwards and inwards to the base of the bladder. There is a slight convexity medially, the right lying somewhat farther from the mid-line than does the left. The inferior vena cava lies between the two. The ureters rest on the surface of the psoas major muscles and are covered entirely by peritoneum to which they are attached by areolar connective tissue. The spermatic vessels cross obliquely over the abdominal portion, from above and inward to below and outward. On the left the ureter crosses the distal portion of the common iliac artery and on the right the external iliac in its proximal part, before entering the pelvic cavity. In the male the pelvic portion is crossed at right angles by the vas deferens and after passing beneath the internal iliac vessels and obturator nerve reaches the posterior surface of the bladder.

Microscopically this organ consists of three distinct layers. The outer coat or adventitia consists of connective tissue with some elastic fibers, vessels, nerves, a variable amount of fat and a fibrous capsule which is continuous with the fibrous coat of the bladder. The middle layer is the tunica muscularis which is

0.3 to 0.5 mm. in thickness and represents one-half or more of the diameter of the wall. In spite of some differences of opinion it is generally agreed that the muscle coat consists of three more or less distinct layers. There is the middle circular layer which is of chief importance, a less well defined inner longitudinal layer and an even more poorly developed external layer, also longitudinal. The last named layer consists of only isolated bundles (Disse) which are entirely absent in the upper ureter. This orderly arrangement is least well marked near the bladder where the musculature of the ureter is most powerful. Between the

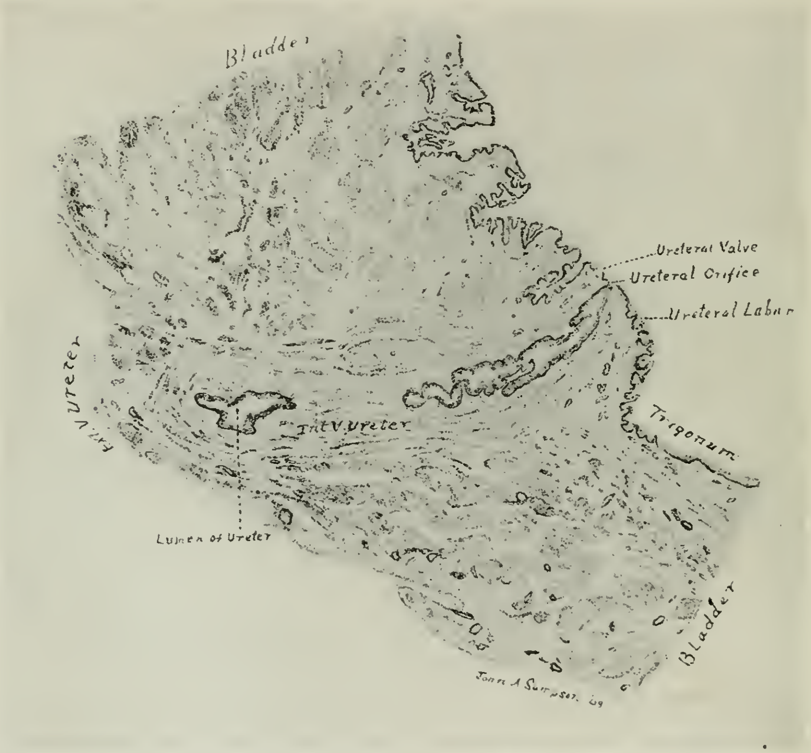

FIG. 1. THE INTRAVESICAL URETER IN AN EMPTY, CONTRACTED HUMAN BLADDER

Drawing by Sampson. The oblique course of the ureter and the ureteral valve are shown. The latter structure becomes more definite as the bladder is distended.

muscle bundles, according to Disse, are spaces filled with connective tissue, equal in volume to the muscle bundles themselves. He describes as a distinct entity the ureteral sheath of Waldeyer which is a layer of longitudinal muscle bundles situated in the adventitia of the distal few centimeters near the bladder. This sheath is divided from the rest of the musculature by connective tissue which also serves to join it to the underlying structures. It is thickest near the bladder and tapers off rather abruptly towards the kidney. On casual inspection this additional muscle layer seems to come out of and be a part of the bladder musculature but Disse has definitely demonstrated its independence from the muscle bundles of the bladder wall.

The mucosa of the ureter presents a stratified epithelium similar to that of the pelvis of the kidney. The surface layer consists of large flattened cells beneath which are several strata of polygonal and globular cells. Capillaries and connective tissue strands enter the epithelium from the submucosa, thus raising it into papillae which are similar to those of the corium of the skin. The submucosa is formed of elastic fibers and connective tissue and blends with the inner longitudinal muscle bundles. It is absent in the distal ureter where the muscle layer reaches the epithelium itself.

The ureteral blood supply comes from the renal, spermatic or ovarian, internal iliac and inferior vesical arteries. The first two supply the pelvis and abdominal portion and the second two the pelvic portion. These vessels reaching the ureter at different levels send out branches along its wall. Smaller arterioles penetrate the substance of the organ at right angles to the surface, again to split into longitudinal branches in the propria. Out of this arises a veritable capillary network, the vessels from all sources anastomosing abundantly. Sampson, for example, by injecting the left renal artery through the open aorta was able to fill without difficulty the entire circulation of the ureter with the injection mass. He also demonstrated that blood supply may come from the aorta and uterine arteries as well as from those mentioned above. The veins begin in the propria and carry their blood to larger vessels at the inner boundary of the muscularis.

These form the venous plexus of the mucosa which is longitudinal but enmeshed by right angled and oblique communicating branches. It drains in turn into a larger plexus visible grossly in the adventitia.

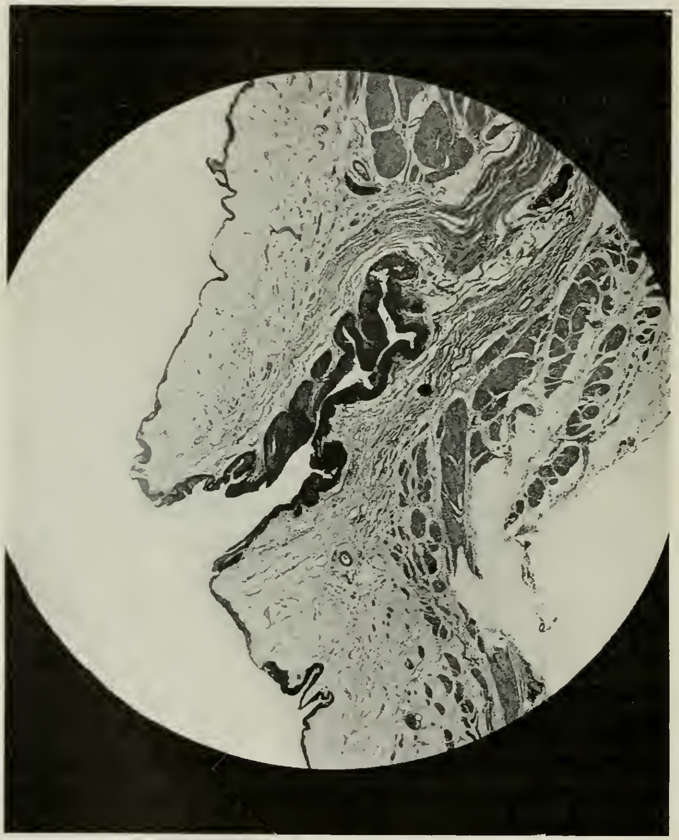

Fig. 2. The Distal Ureter in the Dog

Low-power photomicrograph. Note again the oblique course through the vesical wall.

The lymphatics of the ureter are incompletely studied. According to the work of Krause and that of Sakata, the lymph capillaries in the propria drain into a larger network lying close to the muscle layer. Efferent vessels pierce the muscle and continue in the adventitia. Sakata by injection shows these efferent vessels to be divided into deep and superficial groups. Each group from approximately each third of the ureter drains into corresponding lymph nodes along the iliac vessels, the aorta, and the vena cava. There is no direct lymph channel between the bladder and kidneys, and lymphatic communication if it exists must be either through anastomoses between the lymph capillaries in the different levels of the ureter or through anastomoses between the lymph nodes draining these areas.

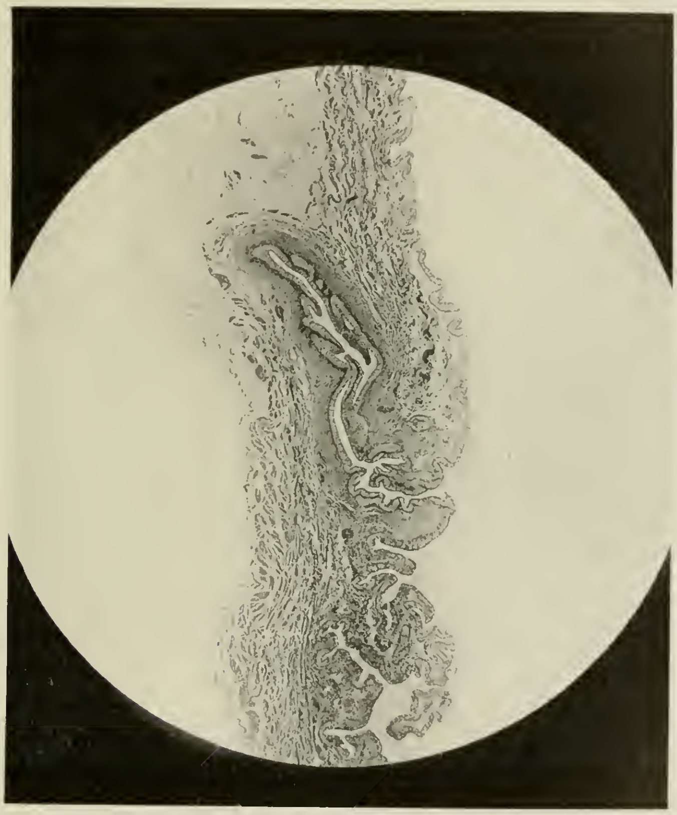

FIG. 3. THE INTRAMURAL PORTION OF THE URETER IN A RABBIT

Low-power photomicrograph. The oblique course through the bladder wall and the resulting valve formation are again clearly shown.

The ureter receives its nerve supply from three sources, the renal, the spermatic and the hypogastric plexuses. The renal plexus supplies the pelvis and the upper half of the abdominal portion; the spermatic supplies the lower half of the abdominal portion; and the hypogastric plexus, the pelvic segment. There are both myelinated and non-myelinated fibers entering with the blood vessels to form a ground-plexus in the adventitia. Numerous ganglia occur in this plexus, the larger ones near the extremities of the organ and smaller ones in the mid-ureter. Out of the ground-plexus, branches to the muscularis arise, but whether or not plexuses and ganglia exist in this layer has not definitely been determined. Some authors have found them (Maier); others (Disselhorst, Engelmann) have not. Disse has observed small ganglia between the muscle bundles, but never in the mucosa. Fine nerve fibers have been noted, however, extending into the mucosa, and sometimes even reaching the epithelium.

It was Disse who undertook to establish the facts concerning the anatomy at the uretero-vesical junction. The ureter does not lose its identity but remains a separate structure with only its mucosa blending with the bladder, at the level of the orifice. Because it meets and passes through the vesical wall obliquely the ureter ends as though cut off obliquely with a shorter anterior and a longer posterior wall. The posterior wall blends uninterruptedly with the bladder mucosa but the upper wall forms a fold which embraces the orifice and is called the ureteral valve (figs. 1, 2 and 3). The intramural portion of the ureter has muscle bundles beginning at and even penetrating the propria. All these bundles are directed longitudinally, that is, parallel to the axis of the ureteral lumen. They are separated from the bladder musculature by connective tissue, no communication existing between the two, and they end in the bladder mucosa. Those of the upper wall end in the valve and those in the lower wall lose themselves in the immediate neighborhood of the orifice. Disse concludes that while in a dead subject filling of the bladder would mechanically close the orifice by compressing the valve, this would not necessarily be true in the case of active musculature where contraction of the intramural ureter might hold the lumen open against intravesical pressure.

PHARMACOLOGY

Most of the studies concerning the effects of drugs on the ureter have been directed toward the solution of the puzzling problem of its innervation. And the answer to this problem pharmacologically has been more definite and satisfactory than the anatomical and physiological efforts.

Adrenalin and *ergotoxin* have been usually chosen to demonstrate the presence of sympathetic fibers. Roth, Macht and Penfield working with excised rings of ureter, and Satani using a similar preparation as well as making observations in situ, have all shown that adrenalin increases the rate, tone and amplitude of ureteral peristalsis. Roth noted no variations in the effect of adrenalin on different parts of the ureter, but Satani found the greatest change in the upper segment, the response decreasing progressively towards the bladder. *Ergotoxin* also increases peristaltic activity in the ureter as demonstrated by both Satani and Macht. The latter has shown, however, that after initial stimulation slowing and relaxation follows, and that if adrenalin is now added greater relaxation occurs. He considers this further proof of the presence of sympathetic motor fibers, for ergotoxin inhibits the motor effect of adrenalin but does not interfere with its inhibitory effect.

Pilocarpin and *physostigmin* have been used to study the presence of parasympathetic nerve supply. Roth, Satani, Macht and Penfield have used pilocarpin and agree that it stimulates activity, although Penfield and Roth feel that this effect is only slight. Macht and Satani working with physostigmin, on both the excised ureter and the organ in situ, have shown that definite stimulation is produced by this drug. The latter found that the greatest effect of pilocarpin and physostigmin may be observed in the bladder segment, with gradual diminution towards the pelvis. There is thus sufficient evidence that motor nerve supply to the ureter comes from both the sympathetic and the parasympathetic systems. Moreover, in accordance with the work of Satani the sympathetic sends most of its supply to the pelvis segment, while the parasympathetic system exerts its greatest influence in the distal portion. The middle segment of the ureter is equally supplied by both.

Atropin. Roth found his studies with this drug unsatisfactory, and Penfield could demonstrate only a slight amount of depression following its use. Protopopow, Macht and Satani, however, have shown definitely an initial stimulation followed gradually by cessation of motion. Thus we are furnished with another proof of the presence of motor fibers from the parasympathetic system.

Nicotin. Most workers have shown this drug in small doses first to stimulate and then to inhibit ureteral activity, while large doses immediately paralyze the organ. These facts prove, of course, the presence of ganglion cells. Satani, who studied the effect of nicotin on segments taken from each third of the ureter obtained the same result in every instance.

The above drugs have been studied by most of those interested in the pharmacology of the ureter. A few isolated observations have been made in addition. Roth, for example, found that procain and cocain stimulate the activity of excised segments. He also showed that apocodein has about the same effect as ergotoxin. Satani, searching for additional information concerning the origin of peristalsis, perfused ureters with solutions of uric acid and urea and found both of them to stimulate activity. Macht, working on the rate of absorption from the urinary tract, showed that aconitin, cocain, apomorphin and potassium cyanid are easily absorbed through the walls of the ureter and pelvis. A crystal of barium chlorid placed on the surface of the ureter produces a constriction ring from which peristaltic and antiperistaltic waves arise, as demonstrated by Penfield, Wislocki and O'Conor, and ourselves. An increase of normal peristalsis may be observed, also, when the drug is administered intravenously. Protopopow showed that diuretin has no effect upon the ureter. He found also that caffein in small doses accelerates and in large doses diminishes ureteral activity.

PHYSIOLOGY

The ureter is not simply a passive conductor of the urine, but an active organ, the function of which is to transport the secretions of the kidney to the urinary bladder. This it accomplishes through rhythmic peristaltic contractions. Careful work has been done on the physiology of this organ by numerous earlier investigators. Notable among them was Engelmann in 1869. For fundamental observations his studies have not been surpassed. He performed his experiments on the ureters of rabbits, in situ, and described the peristaltic waves as consisting of (1) distention with urine, (2) a slight rise of the ureter towards the kidney, (3) contraction downwards, and (4) relaxation; with an accompanying change in color from pink to white to pink again due to the constriction and relaxation of the blood-vessels in the ureteral wall. He found the average speed of the waves to be from 20 to 30 mm. per second and the rate of contraction from 6 to 3 per minute. No antiperistalsis was noted normally.

Pinching the ureter at any point caused waves of equal speed in both directions from the point of stimulation. Cooling depressed, and warming restored irritability. Disturbed circulation also produced depression. All these factors affected not only irritability but in varying degrees the conductivity and contractility as well. Engelmann thought, further, that there was a definite refractory period during which stimulation was ineffective, at least 10 seconds between waves being necessary before complete rest could occur. He felt that in life, smooth muscle is a syncytium and that contractions are transmitted by molecular activity without the interrelation of nerves. The origin of the contraction wave he ascribed to an inherent quality in the musculature, though this may be affected by the increase or decrease of fluid in the lumen or by stimulation from the chemical composition of the fluid itself. Engelmann suggested that the explanation for the pelvis origin of the waves lay in more favorable conditions for irritability in that region, such as better blood supply. Thus this worker foreshadowed more than fifty years ago, Child's modern theory of metabolic gradients.

Protopopow (1897) divided the peristaltic wave into a systole and a diastole. He reviewed the opinions of various authors on the origin of the contractions. Some of them felt that they are altogether dependent upon the stimulation of the urine, others believed them to be under the control of the central or peripheral nervous system. Still others thought that they occur as the result of an energy inherent in the ureteral musculature. From his own series of experiments he concluded that: (1) Asphyxia stimulates peristaltic activity. (2) Closure of the renal artery and cessation of secretion causes temporary decrease in the frequency of waves. (3) Anemia of the abdominal organs by closure of the aorta above the level of the renal vessels results in markedly diminished ureteral activity. (4) Increasing the quantity of fluid in the ureter produces greater peristaltic efforts. (5) Cessation of secretion by separating the kidney from all its proximal attachments slows activity temporarily, but tying the ureter at the pelvis level results in depression followed by complete inactivity. Protopopow believed this result to be due not only to the exclusion of urine but also to the blocking of the nerve supply from above. He also brought forth some evidence to show that the anastomosis between the inferior mesenteric ganglion fibers and the hypogastric plexus, gives off motor twigs to the ureters. Cutting the major splanchnic, he found, depresses ureteral activity and stimulating its peripheral stump increases it. The latter effect is not observed if the ureter is tied at the pelvis level.

Sokoloff and Luchsinger (1881) worked on fresh excised ureters which they filled with fluid at varying gravity pressures and concluded that within limits, the greater the stretching of the ureteral wall the more frequent and the stronger will be the contractions.

Lewin and Goldschmidt (1893) believed urine in the ureter to be the stimulus to contraction and denied a central nervous system control. They found that pressure on the kidney produced peristaltic waves and explained this by saying that such pressure forced urine into the ureter from the kidney pelvis. In the same way they felt that fluid forced into the ureter from the bladder produces waves in the opposite direction.

Lina Stern (1903) showed by graphic records from excised ureters the effects of changes in temperature upon peristalsis, and proved that lowering the temperature slows the activity, while warming, up to certain limits, increases contraction. Heating beyond that limit causes caloric death.

Sampson (1903) also considered fluid pressure within the ureter as the chief stimulus to contraction. He felt that such other factors as gravity, contraction of the diaphragm and abdominal muscles, intestinal peristalsis and arterial pulsation also aid in the propulsion of the urine downward. He demonstrated in the dog that bladder distention increases the rate of ureteral activity. He denied the existence of antiperistalsis in the ureters of dogs and humans.

Henderson (1905) again showed that pressure within the ureter increases the rate of peristalsis within certain limits. Contractions disappear with pressures of 26 to 32 mm. Hg., in dogs, and 8 to 16 mm. Hg in rabbits. He stated that stimulation of the hypogastric and splanchnic nerves will often produce waves in a ureter which seems paralyzed from too much distention. In dogs he demonstrated a rise in intraureteral pressure of 36 mm. Hg with each peristaltic wave. In rabbits the maximum elevation was 12 mm. Hg.

Lucas (1906) studied graphically the activity of the upper, middle and lower thirds of the ureter in dogs, with these organs in situ. He showed the characteristic activity of the pelvis to be a fine, rapid oscillation. The upper portion of the ureter presents similar oscillatory movements, but these are a little larger and less frequent than in the pelvis. In the mid-ureter are found relatively infrequent larger waves of peristaltic contraction. Upon these, especially in the presence of fatigue and depressant drugs, may be superimposed the fine oscillations usually confined to the pelvis. In the lower segment contractions are smaller than in the mid-ureter.

Alksne (1907) on the basis of his own work together with that of other investigators, which he carefully reviewed, concludes: (1) The ureter has intrinsic movements depending upon the activity of its nerve cells, but these movements are modified by various external factors such as changes in the temperature, composition of the blood, excretion of urine, pulsation of vessels, etc. (2) Cutting across the ureter for more than one-third of its diameter puts an effective barrier in the path of all waves. Partial obstruction allows only some of the contractions to pass by the obstructed area. Atony of 1 cm. or more of the length of the ureter acts in a similar manner.

Boulet and Gley (1913) studied fresh human ureters and found that the frequency of contraction of the upper portion is greater than that of the middle and lower segments.

Roth (1917) working with excised ureters, described two types of contraction waves, small ones characteristic of the kidney region and larger ones found in the middle and lower thirds. He believed also that the contractions in the middle and distal ureter are more vigorous than those occurring in the pelvic portion. He found, further, that lowered temperature decreases the rate, tone and amplitude of the peristaltic waves, while raising the temperature, within limits, reverses these effects. He placed the optimum range of temperature for dogs' ureters at 37 to 39°C.

Satani (1919–1920) concludes that "the ureteral movements are produced by various mechanisms such as stimulation of the motor nerves, distention of the lumen and chemical effect of the urine, each of which may alone cause contractions of the ureter or which may coöperate with one another." He adds that the viscosity of the fluid effects peristalsis to a very slight degree, while solid bodies within the ureter cause vigorous tonic contractions.

Penfield (1920) studying particularly ureters dilated as a result of experimental obstruction, demonstrated that the stimulus of freshly secreted urine in the pelvis is not essential for peristalsis. In his opinion the "pacemaker" of the ureter is probably located in the pelvis where the highest rate of contraction exists. He explained the downward course of ureteral waves on the basis of metabolic gradients.

Wislocki and O'Conor (1920) found that the ureter responds to the presence of foreign bodies such as glass beads or ureteral catheters, by increased peristalsis and never by any antiperistaltic activity.

Our own work on the physiology of the ureter was incidental to our study of regurgitation. We have nevertheless, through the course of a long series of experiments, been able to confirm many previous observations, and to correct erroneous conclusions in some instances. Since most of our physiological studies were made in the earlier experiments in which rabbits were used, much of our information has been gained from these animals.

Waves of peristalsis vary in frequency in the normal ureter, occurring from 1 to 5 times per minute. Because of the greater amplitude of the contractions in the mid-ureter they are best observed at that level. There occurs in sequence at a given point, first a wave of dilatation (the column of urine that is being propelled bladderwards), followed closely by the wave of contraction (the propelling power) which seems to carry the ureter downward for a short distance; and lastly an upward relaxation which restores the given point to its position of quiescence. These events are less easily distinguished in the upper ureter where only undulatory movements may be discerned. The amplitude of the contractions, as indeed their frequency and speed, vary in different subjects and in the same subject, with the degree of irritability and conductivity of the ureteral musculature at the time of observation. In general the speed of the peristaltic waves is greatest in the upper third of the ureter and least in the lower third. Average figures in about 20 experiments were 18.3 mm. per second for the upper third, 15.4 mm. for the middle third and 13.3 mm. for the distal segment.

In one series of experiments partial ureteral obstruction of varying degree was produced with aluminum or elastic bands, and complete obstruction with silk ties. Examination of these animals was made some weeks after operation, allowing thus an opportunity for the effects of the obstruction to become established. The modification of normal anatomy and physiology is worthy of note. Slight partial obstruction resulted in mild hypertrophy without dilatation, and peristalsis remained practically unaffected, the waves continuing through the length of the ureter, unimpeded by the band. In those cases where obstruction was almost complete the ureter above the obstruction was much hypertrophied and considerably dilated. Peristalsis, however, continued uninterruptedly down the ureter. In the hypertrophied, dilated portion the component parts of the waves were less easily distinguishable, probably because of the fact that constriction did not result in complete temporary obliteration of the lumen as in an undisturbed ureter. The segment below the band appeared to be normal, but the phase of dilatation of the wave seemed to precede the constriction by a longer interval than commonly observed. This we believe was due to the fact that the column of urine forced out of the dilated portion was longer than usual. The frequency of contraction on the obstructed side varied considerably, but on the whole averaged a little less than on the normal side. The speed of the waves also varied widely but in general the less the obstruction, the more nearly normal relative speeds existed in the segments above and below the band. In the much hypertrophied and dilated upper segments the speed was definitely less than in the lower unobstructed ones.

In those cases where complete obstruction existed there was marked dilatation with thinning of the ureter and pelvis above the obstruction, increase in length as shown by tortuosity, and haustration resembling that seen in the large bowel. These changes were in sharp contrast to the incompletely obstructed ureter in which the wall was thickened and the contour quite uniform. Below the tie the organ seemed atrophied. The latter appearance was probably due to the fact that this segment was usually empty of urine and collapsed. In such ureters peristalsis was seldom noted. Those waves that were seen usually consisted of shallow ripples that did not advance much beyond their point of origin in the pelvis.

In 1 case (experiment 39) in which a left nephrectomy had been performed ten days before experiment, the ureteral stump was found to be in motion when exposed to view. Upon analysis this was shown to be normal peristaltic activity, without, of course, the presence of urine. Later, reflux occurred into the stump and peristalsis was stimulated as in a normal ureter.

In only 3 cases of all our experiments did we observe anything suggesting reverse peristalsis not artificially produced. In 1 previously normal ureter following regurgitation there occurred in the bladder segment a brief series of constrictions which extended for a short distance upwards and suggested possible antiperistalsis. In another case in the lower segment of a completely obstructed ureter somewhat similar changes were observed following reflux. In the last of the 3, a case of partial ureteral obstruction, we saw two waves of reverse peristalsis, one from the obstructing band to the pelvis, the other beginning at the bladder and also reaching the kidney. It may likewise be mentioned in passing that not only did antiperistalsis fail to appear as a result of regurgitation in practically all of our cases, but that direct injection of fluid into the ureter from below upwards resulted merely in waves of contraction beginning in the pelvis and proceeding in the normal direction, the point of puncture for injection seeming to act as an area of block beyond which waves did not descend.

On 2 occasions in which the ureter was dilated and the bladder very full there seemed to be dissociation of the normal ureteral rhythm to such an extent that two separate parts of the ureter contracted independently with varying time intervals. The two segments seemed to be obedient to two separate "pacemakers," as though the dilatation of the ureter, or the increased intravesical pressure, or both, had produced temporary interruption of the normal conductivity. In 1 of these cases the ureter was filled with urine, in the other it had just become distended with regurgitant fluid from the bladder.

As has been said, the normal ureter is subject to the changes in irritability, contractility and conductivity characteristic of other smooth muscle organs. We have observed the effects of a variety of external influences. In the few cases in which observations were made under primary anesthesia, struggling of the animal had no apparent effect upon ureteral activity. Prolonged deep anesthesia, other factors being constant, seemed to be followed by depression. Chilling of the preparation inevitably slowed the contractions while rewarming restored the normal rate. Barium chlorid crystals applied to the surface of the ureter produce constriction rings from which contraction waves go out in both directions. Depending upon the state of irritability of the ureteral musculature these waves vary from barely perceptible ripples to definite peristaltic movements. The areas of constriction persist for considerable time as areas of block beyond which descending waves do not pass. Given intravenously in proper dosage this same drug stimulates normal ureteral activity. Mechanical stimulation by pinching or cutting acts in the same manner as does the local application of barium chlorid crystals. In dogs we found that gentle rubbing of the surface with gauze produced peristalsis in an otherwise inactive ureter.

We have had particular opportunity to observe the effect of bladder distention upon ureteral activity. When the bladder begins to fill there is a speeding up of peristalsis. With greater degrees of retention, and increased intravesical pressure, the ureter acts more slowly, but more vigorously, its greater tone being evidenced by blanching throughout its whole extent. Where intravesical pressure has reached a relatively high level the ureter again speeds up in frequency but becomes dilated and increasingly ineffective in emptying its load. Finally fatigued, and overdistended, its waves become mere ripples and eventually cease. In other words, there has developed a ureteral retention which is inevitably associated with bladder retention—a fact too little regarded in clinical condiderations, and one which gives definite significance to the term "back pressure" in prostatic obstruction.

The immediate effect of regurgitation on the ureter, as will be seen later, is a sudden increase in rate and vigor of peristaltic activity as if in an effort to expel the invading fluid. There are two possible results of this conflict: either the increased activity succeeds in eventually forcing out the bladder fluid so that the ureter returns to its normal peristalsis; or the waves become increasingly inefficient until the organ is finally distended and motionless, its lumen filled as in our experiments, with colored vesical contents. We have practically never seen antiperistalsis resulting as a sequence of regurgitation.

Keeping still in mind the question of prostatic "back pressure" it seems to us of especial interest that after regurgitation the bladder pressure is transmitted directly to the renal pelvis, the two structures being in open communication. This we demonstrated in 6 cases in which we measured the intrapelvic pressure by means of a water manometer. The latter was attached to a small cannula passed into the pelvis through the kidney parenchyma. The average bladder pressure at the time of regurgitation in these cases was 21.8 mm. Hg while the pelvis pressure was 26.9 mm. of water or about 20.7 mm. Hg, the difference not beyond the limits of error. When the vesical tension is reduced, pelvis pressure remains elevated until ureteral contractions produce sufficient emptying to lower it. No reduction in pelvis pressure occurs if the ureters remain inactive. In experiment 121, for example, reflux occurred with a bladder pressure of 22 mm. Hg. Pressure in the renal pelvis promptly rose to the same level. Upon emptying the bladder the ureteral orifice apparently closed and no waves occurred in the ureter, for pelvis pressure still remained 22 mm. Hg.

METHODS

The technique which was used throughout our work was based upon certain fundamental procedures which we will outline in detail.

In the series under discussion the experiments were carried out upon male rabbits. In most instances the animals were anesthetized with urethane (1 gram per kilogram of body weight) given by means of a stomach tube, and morphia ($\frac{1}{8}$ grain) given subcutaneously. In order to exclude the possible influence of urethane, paraldehyd (1 gram per kilogram) was used in its stead with sufficient frequency, for control purposes. In some instances the urethane or the paraldehyd was used alone without morphin. In a large number of cases, a small amount of ether was given in addition, for complete anesthesia during the early stages of the preparation. Occasionally the urethane was given rectally. After an interval, usually of thirty minutes, allowed for satisfactory anesthesia, the animal was placed in a warm chamber in which body temperature was maintained by a thermostat and equalized throughout by means of a small electric fan.

A mid-line incision opened the peritoneum from ensiform to pubes. The rectum was usually doubly tied and cut and the intestines were reflected upwards and to one side where they were enclosed in a towel moistened with warm physiological salt solution. For this procedure it was only necessary in addition to dividing the mesocolon, to ligate and cut the inferior mesenteric artery. The vessel was divided peripheral to the inferior mesentery ganglion and its fibers. In this way the bladder and the ureters throughout their extent were exposed to view. The tissues were kept moistened with physiological salt solution at body temperature. To exclude the possible effects of shock a few experiments were performed in which the rectum was not cut across, the intestines being merely turned aside to expose one ureter, and we found this preparation no more favorable for the production of regurgitation than the other. In numerous cases the abdomen was not opened at all until the close of the experiment.

The bladder was now emptied of its contents, varying in amount from a few cubic centimeters to occasionally 100 cc. or even more. The emptying was accomplished with a small, soft rubber catheter passed through the urethra. The catheterization of a male rabbit is very easily performed and while we usually made use of size no. 11 French, larger sizes could easily be passed. We will repeat the admonition of Courtade and Guyon, however, that the procedure must be gently and slowly performed lest the catheter tip leave the urethra and enter the seminal vesicles. The opening through which these structures communicate is, in the rabbit, unusually large. In many instances we catheterized the animal soon after giving the anesthetic, thus insuring a relatively empty bladder at the time of opening the abdomen. When all preparations were complete we usually allowed an interval varying from fifteen to forty-five minutes before actually beginning bladder filling. During this period body temperature was reëstablished in the chamber if any slight chilling had occurred. Moreover and perhaps of greater importance, the bladder musculature was given a definite rest period in the empty state.

From a burette, the maximum hydrostatic pressure of which was about 50 mm. of mercury the solution to be used was slowly introduced through the catheter into the bladder. The fluid in all cases in this series was physiological salt solution (0.85 per cent) colored with small quantities of 1 per cent aqueous methylene blue or India ink, merely for purposes of increased visibility. A coil of tubing immersed in a water bath and inserted between the burette and the catheter served to maintain body temperature in the solution introduced. The rate of flow into the bladder ranged from 1 to 2 cc. per minute.

In a few cases we filled the bladder through the urethral catheter by means of a syringe in order to compare our method with that used by most of the earlier investigators. While the final results were not essentially different, we found this method less convenient and less easily controlled. In a few other cases we attempted filling with a syringe, and hypodermic needle inserted directly through the vesical wall. This we found highly unsatisfactory and unreliable. In 1 case we demonstrated that it is easily possible to fill the bladder through one ureter and produce regurgitation upon the other side.

A mercury manometer in open communication with the system made it possible at all times to read intravesical pressure. Filling was continued until positive results were obtained or until such time as further filling would have been beyond physiological limits of distention.

SERIES A: A SERIES OF NORMAL RABBITS, THE BLADDERS OF WHICH WERE FILLED WITH WARM PHYSIOLOGICAL SALT SOLUTION

In this series are included experiments upon 73 male rabbits with a total of 76 bladder fillings. It was our purpose to simulate as closely as possible the normal vesical distention. Body warm physiological saline was slowly introduced and trauma in the preparation of the subject was reduced to a minimum. By these means we were able to secure regurgitation of vesical contents into the ureter in a total of 73.7 per cent of the cases. Most of the failures occurred in the early stages of the work when we were less familiar with the technique of preparation. In the second half of the series we produced regurgitation in 86.8 per cent of the attempts.

A typical experiment proceeded about as follows:

Experiment 29. October 27, 1921. Gray male rabbit; weight 2.4 kgm. Urethane (1 gram per kilogram) by stomach tube and morphin ($\frac{1}{8}$ grain) subcutaneously. Preparation in about three-quarters of an hour, and at this time a small amount of ether was given. The work was done in the thermostat chamber with the atmosphere maintained as nearly as possible at the level of the rabbit's body temperature. Abdomen opened from ensiform to pubes; rectum doubly tied and cut. Inferior mesenteric artery doubly tied and cut. Intestines reflected upward and to the right exposing bladder and both ureters in their full extent. Tissues kept moistened with body warm normal saline. Animal carefully catheterized; very small amount of urine obtained (2 cc.). Rest period of twenty minutes during which bladder contracted down well. It seemed to possess good muscle tone. Fluid prepared and warmed to body temperature (100 cc. physiological salt solution and 5 cc. of 1 per cent aqueous methylene blue). Filling began, with a rate of 1 to 1.5 cc. per minute.

At the beginning of filling, both ureters were acting vigorously, each presenting three peristaltic waves per minutes and each wave obviously accomplishing the transportation of a considerable amount of urine. When 10 cc. had been introduced into the bladder the ureters were still active and the bladder was elongated and apparently resisting distention actively, as shown by its cylindrical form. Rhythmic undulatory contractions of the vesical musculature were observed. Pressure 5 mm. Hg. With 20 cc. the pressure was 9 mm. Hg.; the bladder was quiet and both ureters were active. With 26 cc., a sudden rush of a blue column of fluid from the bladder into the left ureter filling its lumen to the kidney. Similar reflux soon followed on the right. Pressure 18 mm. Hg. Ureteral waves rapidly increased in frequency, now acting 8 to 10 times a minute. At first these waves successfully pushed the blue columns downward. Gradually, however, the contractions grew less effective until finally the ureters, becoming more and more feeble, lay blue and motionless (plate 1).

The bladder was now partially emptied and the pressure thus reduced allowed the ureters to become active so that they succeeded in emptying themselves in about five minutes. The bladder was then refilled and reflux again occurred with 26 cc. of fluid, and a pressure of 16 mm. Hg. Upon allowing the preparation to stand for a brief interval the fatigue of the vesical musculature lowered the tension slightly, but sufficiently to permit the ureters again to empty. Then the introduction of about 1 cc. of fluid from the burette restored the pressure and once more produced regurgitation.

In this work we have demonstrated conclusively that regurgitation of the vesical contents is an experimental fact. To be sure, as we have previously stated, so much has been shown by earlier workers. There has thus far, however, been no satisfactory explanation of the phenomenon, no complete analysis of the factors by which it is produced. It has been our purpose, therefore, to determine, if possible, the conditions under which reflux occurs; and a careful review of the results of the present "normal" series will be of value. Apart from the general consideration of anesthesia it is convenient to discuss separately the bladder and the ureter and then the interrelationship of these two structures with their bearing upon the phenomenon of regurgitation.

Concerning anesthesia, suffice it to say that nine different combinations were used of urethane, paraldehyd, morphia and ether. Urethane seemed more ideally suited to our purposes. It possesses excellent anesthetic properties, it is not profoundly depressing and it has a mild diuretic effect. In those experiments in which paraldehyd was used, and especially in which in addition the condition of the animal required the use of large amounts of ether, there seemed to exist a certain amount of depression. But as far as could be determined statistically the type of anesthetic, and the fact of anesthesia as such, was of relatively small importance.

Relationship of bladder to regurgitation

It was of interest to observe the varying amounts of urine present in the animals at the start of the preparation. In 53 of the 73 cases the bladders were either empty or contained 10 cc. or less. Eighty-eight per cent of these cases permitted the occurrence of regurgitation, while in those cases in which the bladders contained moderate or large amounts of urine only 44 per cent showed reflux. This relationship of initial bladder content to the final successful result of the experiment became very evident

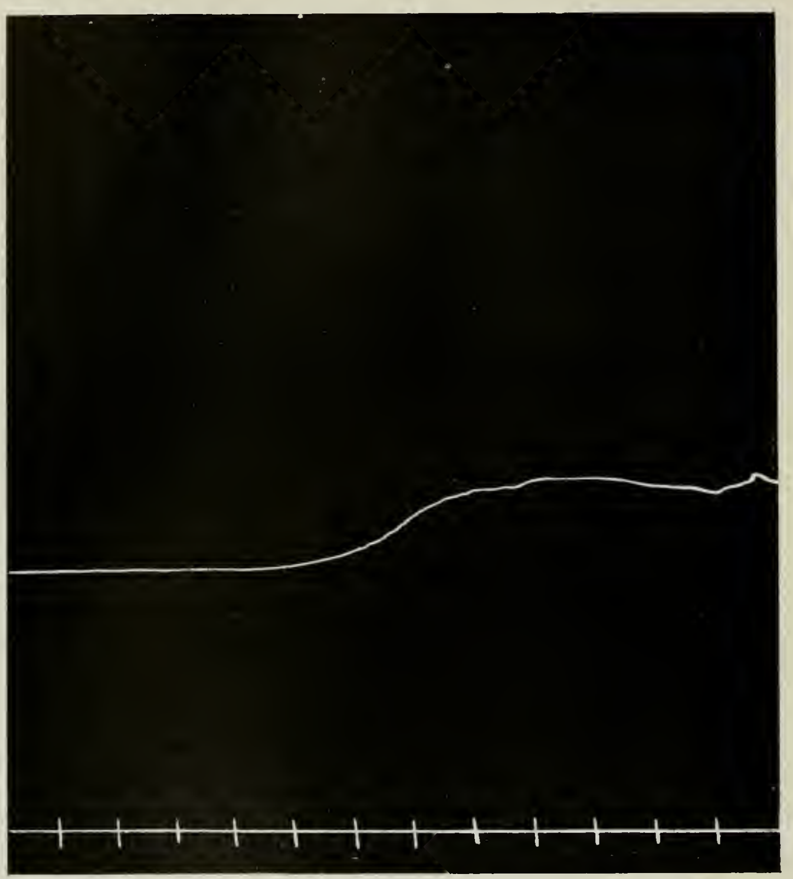

FIG. 4. TRACING OF THE DEVELOPMENT OF INTRAVESICAL PRESSURE IN A GRADUALLY DISTENDED RABBIT BLADDER

Rabbit 172, April 20, 1922. The initial rhythmic contractions were not transmitted to the record. It is in the period of sustained high pressure that reflux occurs. In this case, at the point marked by the arrow, bilateral regurgitation was observed, (23 cc. in the bladder; pressure 29 mm. Hg.).

as the work progressed and we were led frequently to catheterize the animal at the time of the administration of the anesthetic, in order to insure a contracted bladder at the beginning of the experiment, and one which had had a definite period of rest in the contracted state. From this experience it appears to us that at a given time any given bladder possesses the ability to raise and maintain a definite pressure with a given quantity of fluid, entirely different from the pressure which the same bladder can develop at another time under different conditions.

The vermiform activity of the filling bladder, to which we referred in protocol 29, is caused by rhythmic contractions of the musculature stimulated by gradually increasing distention. As the upper limits of intravesical tension are approached, these rhythmic movements cease to be apparent and in their stead occurs a sustained contraction of the bladder wall upon its contents. It is in this tonic state that pressure within the bladder rapidly rises until such levels are reached as render reflux possible (fig. 4).

In the period of rhythmic activity, the muscle fibers are lengthening as filling proceeds. The intermittent contractions represent a sort of clonic response to the stimulus of stretching or distention. Later, further stretching is continuously resisted, and the state of tonic, sustained contraction is reached. In other words, the bladder at first apparently responds to the gradual filling, isotonically, that is by increasing the length of the muscle fibers without changing the tension (except for the periodic contractions described above). Finally, when a sufficient quantity has been introduced, the response becomes isometric; the fibers maintain the same length and respond to the stretching force by a rapidly increasing tension.

Our experiments demonstrate the fact that reflux is attained most rapidly or with the smallest quantity, in those bladders in which the response tends to be isometric from the start. In some cases tone was so active and the isometric state was reached so soon that intermittent contractions were not observed at all, and in these cases reflux pressure levels were developed with surprisingly small quantities of fluid. In other instances, however, and indeed in the majority of the experiments, a rhythmic activity preceded the final tonic resistance to filling. A third type of bladder occurred, so lacking in tone, that muscular contractions failed to appear at all, or did not get beyond the rhythmic state. These bladders presented no active resistance to filling and in them the pressure finally engendered was purely a passive, mechanical tension produced because the sac could hold no more. In such cases, regurgitation never occurred.

Rabbit 5. Brown and while male; weight 2.42 kgm. September 26, 1921. Urethane and morphin anesthesia. Usual preparation. Intestines turned aside; no trauma or bleeding. Ureters amply exposed for observation. Moderately full bladder emptied through catheter. Catheter fixed in position by ligature around the penis. Box temperature regulated. Ureters noted to be acting sluggishly at the rate of about one contraction per minute. Filling begun one-half hour after emptying of bladder. Rate about 1 cc. per minute. Bladder seemed toneless in that it filled like a lifeless sac flattened against the posterior body wall upon which it rested. No rhythmic contractions observed. With 40 cc. pressure 5 mm. Hg. With 60 cc., same ureteral activity; pressure 5 mm. Hg. With 80 cc., same ureteral activity; pressure 7 mm. Hg. With 100 cc., left ureter less active; pressure 5 mm. Hg. The 100 cc. were readily introduced into the bladder which seemed quite incapable of active resistance. No regurgitation.

The average quantity of fluid used in bladder filling in this series was 49 cc., and in the second half of the series, 30 cc. These quantities are not excessive in rabbit bladders for we have frequently found much larger quantities of urine in these animals at the time of preparation. We considered that the upper limits of capacity had been reached in a given case when reflux had occurred, or when the quantity introduced had approached the 100 cc. mark; or when evidence of thinning of the vesical wall had occurred. The largest amount of fluid used was 184 cc. in experiment 12 and the smallest quantity was 8 cc. in experiment 119. This wide variation is striking when it is considered that animals of fairly uniform size and weight were used. It is also noteworthy that in no. 12 (184 cc.) the upper limit of pressure was 12 mm. Hg while in no. 119 (12 cc.) a pressure of 13 mm. of Hg was reached. This demonstrates conclusively that intravesical tension does not depend primarily upon the amount of fluid in the bladder but rather upon the tone of the bladder musculature. In the 2 experiments mentioned above, reflux occurred with the small quantity and did not occur with the large.

The amount of fluid necessary to produce regurgitation ranged within the same wide limits. The smallest quantity giving reflux, in this series was 7 cc. while the largest quantity was 145 cc. The average quantity giving regurgitation was 34.8 cc. and in the second half of the series, with better preparations, 23.2 cc.

The intravesical pressure at the time of reflux did not vary, markedly. The average for the whole series was 13.6 mm. of mercury; for the first half of the group, 14.8 mm.; for the second half, 12.3 mm. of mercury. The more active tone of the bladders in the second half of the series is again shown by the fact that practically the same pressure levels were reached in spite of the much smaller quantities used. It is certain that active pressure is the primary consideration, while the quantity used to produce it is of relatively small consequence. The highest pressure reading that we have recorded, with which reflux occurred, was 50 mm. of mercury (experiment 32). This was produced, however, with 130 cc. of fluid. The lowest pressure of reflux was 4 mm., reached with 11 cc. of fluid (experiment 91).

Realizing the importance of bladder tone in regurgitation we attempted to improve this factor in a few of the more or less toneless bladders. Handling the organ or exposing it to chilling produced slight increase in the tone of the vesical musculature but this was never sufficient to cause appreciable increase in tension. Asphyxia gave no change in intravesical pressure except that which could easily be explained by the struggles of the animal; certainly no sustained increase occurred. Direct electrical stimulation of the bladder resulted in local contraction without general effect. Electrical stimulation of the femoral nerve was followed by rhythmic movements without demonstrable alteration in pressure. Squeezing the bladder with the fingers and passively raising its pressure had no effect in producing regurgitation. In order to control the possible influence of dividing the abdominal wall we allowed the abdomen to remain intact in many cases and found that there was no difference in the final outcome of the experiments. This we expected in view of the fact that the contraction of the abdominal muscles can add only passively to bladder pressure.

Stimulated apparently by the distending bladder we have observed on numerous occasions spasms of the genitalia with rhythmic contractions of the pelvic floor, resulting in intermittent rises of intravesical tension. This pressure being unsustained, seldom resulted in regurgitation, but being active pressure—that is pressure to which active contraction of the bladder musculature contributed—it is conceivable that if this spasm should occur at a propitious moment the added increment of pressure might produce reflux.

With regard to the condition of the bladder at the close of the experiment, our figures show that 52 cases (93 per cent) in which regurgitation occurred presented perfectly intact bladders at the time of reflux. In three experiments in which regurgitation took place, there was evidence of imminent rupture as shown by areas of thinning of the vesical wall or seepage through it of colored fluid. The quantities used in filling in these cases, were 85, 90 and 145 cc. Of the cases in which we did not obtain reflux 20 per cent showed some damage of the bladder wall. There is ample evidence in this record that the phenomenon which we are studying does not require for its production excessive quantities or pressures. It seems reasonable, further, to conclude—both from the fact that so high a percentage of injuries to the bladder wall occurred in the unsuccessful experiments and also that in those cases of reflux in which the bladders were damaged the quantities used were far above the average—that damage occurred more frequently in the toneless organs, incapable of regurgitation. This situation finds analogy in the repeated and futile efforts of other workers to produce reflux by over-distention of the cadaver bladder. Such attempts, as is well known, have invariably resulted in rupture, without the occurrence of regurgitation.

Our usual procedure in these experiments was to secure the urethral catheter by a ligature around the penis, but in several cases this tie was omitted and contraction of the bladder neck was depended upon to prevent leakage of fluid around the tube. In a majority of these cases a leak of colored solution occurred before reflux pressure levels were reached. But in some instances bladder tension was raised to the point of ureteral reflux without relaxation of the vesical sphincter.

Experiment 17D. Male rabbit; 1.9 kgm. February 2, 1922. Usual preparation of animal. Ureters both doubly tied and cut near kidney pelvis (for purposes of experiments then in progress). Urethra easily catheterized; *not tied.* Bladder contained only a few cubic centimeters and seemed to possess good tone. Filling started about one hour after anesthesia. With 6 cc., complete regurgitation on the right, followed quickly by regurgitation on the left side. Pressure 20 mm. Hg. Bladder sphincter did not give way. Preparation allowed to stand for one hour; sphincter still unrelaxed.

This point seems to us of significance, for a clinical analogy would be found in a patient in whom reflux occurred as a result of either voluntary or spasmodic sphincter contraction without the presence of any other mechanical obstruction.

SERIES B: RABBITS IN WHICH THE URETERS HAD BEEN DISTURBED IN PREVIOUS OPERATIONS

This group consisted of 42 bladder fillings in 38 male rabbits. In each case the normal conditions existing in one or both ureters had been disturbed in a previous operation, performed either some weeks before or immediately preceding the experiment. In 15 animals (group 1) the operation had produced obstruction in the left ureter, varying in degree from slight to absolute obliteration of the lumen, by means of aluminum or elastic bands and silk ligatures. In 18 cases (group 2) the ureters were doubly tied with silk and cut across, just before the beginning of the experiment. In 5 rabbits (group 3) the left kidney and ureter were dissected free from all nerve and blood supply down to the bladder wall itself in order to render that side entirely motionless. Otherwise, the conditions of experimentation were essentially the same as in series A.

Taking the series as a whole, we succeeded in producing reflux in 33 of the 42 attempts or in 78.7 per cent of the cases. Of the 5 in which the left side had been rendered motionless, regurgitation occurred in 4 and in all of these the reflux was bilateral, the left ureter being the first invaded in 2 instances. Of the 18 cases in which the ureters were doubly tied and cut, reflux was obtained in 12; and of the 19 vesical fillings in the remaining group (group 1), seventeen or 89.4 per cent resulted in regurgitation. In only 3 of these was reflux unilateral, occurring twice in the normal side and once in the abnormal ureter.

The quantity of fluid necessary to produce regurgitation averaged 35.8 cc. in this series as compared with 46 cc. in series A; and the average pressure was 26.3 mm. Hg as compared with 13.6 mm. Hg in series A. This difference in pressure in the two groups which at first seems to imply that disturbed ureters offer greater resistance to reflux, loses much of its significance when it is recalled that in more than half of the present series normal ureters existed on the right side as controls. And these permitted regurgitation at no lower pressure levels than did the others. The fact that higher pressures were raised in this series, with lower quantities, simply means that bladders of better tone were encountered. The further fact that with these better bladders higher pressure levels seemed necessary for regurgitation in both disturbed and undisturbed ureters is less readily understood. It may be due to the influence of operative interference or may appear simply as a result of the less flexible statistics of a much smaller group. The latter seems to us more probable.

Experiment 47. Black male rabbit; 8.1 kgm. October 13, 1921. Ether anesthesia. Aseptic operation in which an aluminum band was placed about the left mid-ureter for partial constriction of its lumen. Abdomen closed. Good recovery.

November 7, 1921 (twenty-five days after operation), animal found to be in excellent condition. Urethane anesthesia (1 gram per kilogram) with morphin ($\frac{1}{8}$ grain) subcutaneously. Bladder emptied by catheter, of a few cubic centimeters of urine. Usual preparation started about three-quarters of an hour after urethane. Bladder found empty and well contracted. Right ureter normal and contracting vigorously. Left ureter thickened and markedly dilated above the obstruction. Very little scar tissue about the band. Below the band the ureter appeared normal. Vigorous peristalsis was present, the contractions beginning in the pelvis and travelling down the dilated portion, by the band, and onward to the bladder. The waves were ineffective, however, in emptying the hydroureter. In fact the activity was of brief duration and the ureter soon became motionless.

The bladder responded to the distending fluid with rhythmic movements. With 10 cc. the left ureter again began to contract. What appeared to be a wave of antiperistalsis was seen to begin at the bladder and travel in an upward direction to the pelvis. In behavior and speed it resembled a normal wave.[2] With 17 cc. the bladder gave evidence of good tone; rhythmic contractions ceased; pressure: 8 to 10 mm. Hg. Filling continued. At 30 cc. bladder pressure was 36 mm. Hg. Reflux suddenly occurred on the left side, the colored fluid passing rapidly to the region of the band. At the same time regurgitation was observed on the right. The left ureter became distended and motionless as gradually the black column diffused through its whole lumen to the kidney.

The lowest pressure at which regurgitation occurred in series B was 9 mm. Hg and the highest, 50 mm. Hg. The quantities ranged from 6 to 171 cc. In 29 of the 38 animals (76 per cent), the bladders were either empty or contained small amounts of urine at the beginning of the preparation, a fact which as was explained has definite bearing upon the large percentage of cases in which reflux was obtained. In 9 cases the bladder was not entirely intact at the close of the experiment, but 6 of these were not in the regurgitation group. In spite of the abnormal ureters in series B, it is apparent that reflux occurred certainly as frequently as with normal structures. Indeed the percentage of successful experiments in this group is higher than in series A, a result which may be ascribed to the more actively tonic bladders.

Relationship of the ureter to regurgitation

The degree of activity of the ureters, in sharp contrast to the beliefs of other workers, seems to exert relatively little influence upon the occurrence of regurgitation. Indeed, as we have shown, complete absence of ureteral activity does not preclude the possibility of the phenomenon.

The occurrence of antiperistalsis in the normal intact ureter either before or after or at the time of reflux was not observed by us, with the possible exception of a single instance. Forewarned by the emphasis given it by many other students of the subject we zealously watched for its appearance throughout this series, and throughout several subsequent ones to be reported at a later date. Yet at no time could the activity of the ureter be interpreted as peristaltic movement toward the kidney. In a normally acting ureter the contractions increase in frequency as intravesical pressure rises, but always the waves are coursing toward the bladder. Then when reflux occurs, the force behind the regurgitant column may push its way through the oncoming waves of peristalsis and fill the whole ureter to the pelvis; or, a downward directed wave of contraction may meet the invading column more effectively and carry it bladderwards. Frequently the contraction is only partly successful, and after carrying the column downward for some distance it appears to give way slightly and to allow an opening in the lumen of the ureter sufficient to permit the upward directed fluid from the bladder to "slip under" the wave and continue its ascent. This movement of the colored fluid up and down, unless carefully analyzed, may easily be interpreted as an interplay of peristaltic and antiperistaltic waves.

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[2] This is the only reasonably certain example of antiperistalsis seen in all our experiments.

The type of reflux seems in a general way to have varied with differences of peristaltic activity. For example, the rapid, sudden "quicksilver" ascent of the colored column to the pelvis was observed most frequently in the vigorously contracting ureters. The gradual type of reflux, in which the color diffused slowly along the length of the ureter was usually associated with those ureters the contractions of which were enfeebled. We have also noted that the "sudden" reflux occurred with much lower intravesical pressure than did the gradual type.

Neither ureter proved to be more susceptible to regurgitation than the other. In fact, of the 56 positive cases in series A, 44 or 78.6 per cent were bilateral. Where reflux occurred upon one side only, the two ureters were invaded with equal frequency.

The degree of activity of the ureters at the beginning of the preparation, before the start of bladder filling, seemed to have no bearing on the final outcome of the experiment, a fact which was brought out most strikingly in series B.

Inter-relationship of ureter and bladder in the phenomenon of regurgitation

We have seen that the occurrence of regurgitation depends in the largest measure upon the presence of bladder tone, and have also noted that the condition of the ureters is of minor importance. We feel nevertheless that there is an optimum time and condition in cases with tonic bladders and vigorously acting ureters, when reflux is most readily produced. We first became interested in this point by noticing that in such cases when the bladder pressure had become relatively high, the column of urine carried downward by the peristaltic efforts of the distended ureter, seemed to fluctuate or waver rapidly back and forth at the bladder level until it was picked up and carried into the bladder by the next contraction. Furthermore, we frequently noted gradual regurgitation beginning soon after the "waver" was first observed, the colored column from the bladder then taking part in the fluctuation until it had diffused throughout the entire length of the ureter and rendered reflux complete. Upon analysis of these events we concluded that in the cases where this phenomenon took place, regurgitation was facilitated by an interplay of forces existing in both ureter and bladder. When the peristaltic waves of the ureter are competent, the contraction phase causes a complete obliteration of the ureteral lumen from above downward. As this obliteration descends, a column of urine of varying length precedes it. Upon arriving near the uretero-vesical junction, this fluid column forces open the orifice which remains open until the contraction wave itself has completed its course. Now as previously described, the increasing tension in the bladder causes the ureters to dilate, and sooner or later the peristaltic waves become less effective, especially in the distal segment. Our explanation of the "waver" and regurgitation under these conditions, is that a contraction gives way in the lower ureter after the orifice is opened. The obliteration of the ureteral lumen being now incomplete, the urine column plus bladder fluid starts backward toward the kidney only to be met by the next oncoming, still competent wave. This new wave itself becomes incompetent near the bladder and thus the whole cycle is repeated until regurgitation fills the ureter.

While this theory explains reflux in some instances it obviously cannot be accepted as the only explanation or even as the most important one. For as we have shown regurgitation is produced just as readily with ureters which are entirely inactive and in those which are empty of urine. The chief factor in the production of this phenomenon lies in the bladder, for the one indispensable requisite without which we have never been able to obtain reflux, is active tone of the vesical musculature. We believe that tonic contraction of the bladder wall against the distending fluid, particularly in the presence of vesical-neck obstruction, is able to open the ureteral orifice sufficiently to permit regurgitation to occur.

SERIES C: RELATION OF URINARY RETENTION TO REGURGITATION

Rather incidentally in the course of other experiments we attempted in a few instances to produce regurgitation by means of prolonged urinary retention. The method was as follows. After emptying the rabbit's bladder aseptically, from 10 to 20 cc. of warm concentrated India ink or methylene blue were introduced. The catheter was then removed, and under procain anesthesia, the end of the penis was transfixed and tied. The animal was given morphin and returned to the cage. Fluids were supplied by mouth and intravenously, to insure active diuresis. In 2 cases this procedure was varied somewhat, as illustrated in the following protocol. After periods varying from six to twenty-five hours, laparotomy was performed under anesthesia. Of the 7 animals so studied, regurgitation was found to be present in 1 at the time of examination. In another case partial reflux occurred during the inspection of the bladder, without the addition of more fluid.

Experiment 197. Male rabbit, 1.8 kgm. July 11, 1922. Ether anesthesia. Aseptic technique. Left nephrectomy through a flank incision, leaving a ureteral fistula.

July 14, 1922 (after three days). Operative wound practically healed. Mouth of fistula not readily identified. Bladder emptied and 10 cc. of 1 per cent methylene blue introduced. Penis tied (procain). Morphia $\frac{1}{8}$ grain subcutaneously and 24 cc. warm physiological saline intravenously.

July 15, 1922 (twenty-four hours later). No stain about fistula. Bladder palpable through abdominal wall as large, firm mass. Chloralose anaesthesia. Laparotomy. Bladder large and tense (130 cc.), and perfectly intact. Complete regurgitation in right ureter.

The above series is too small to warrant general conclusions, but it demonstrates that regurgitation can occur under these circumstances. This aspect of the problem of reflux should be made the subject of further investigation. We feel, however, that the method just described was not entirely satisfactory in that it affords no means of determining the occurrence of transient regurgitation at some time during the retention period. As Guyon and Albarran have suggested, it is the first stages of urinary obstruction which are marked by violent bladder contractions and these progressively grow weaker and less frequent until complete inactivity supervenes. Reflux would be more apt to occur, therefore, in the earlier hours of retention before the bladder has reached a state of passivity through over-distention and fatigue.

SERIES D: ROENTGENOSCOPIC OBSERVATIONS

It has been our desire to produce regurgitation under conditions as nearly normal as are consistent with experimental study. In order to eliminate as many as possible of the artificial factors, we have made a series of observations on perfectly intact animals. This we accomplished by fluoroscopic examination. Aside from $\frac{1}{8}$ grain of morphia, and a whiff of ether during the adjustment of the catheter, no anesthetic was used. The animals were placed upon the X-ray table and the bladders were slowly filled with warm 25 per cent sodium bromid solution colored with India ink. Observations were made at brief intervals by means of the fluoroscopic screen until regurgitation was seen, or until it was obvious that the phenomenon was not to take place. In 2 or 3 cases we

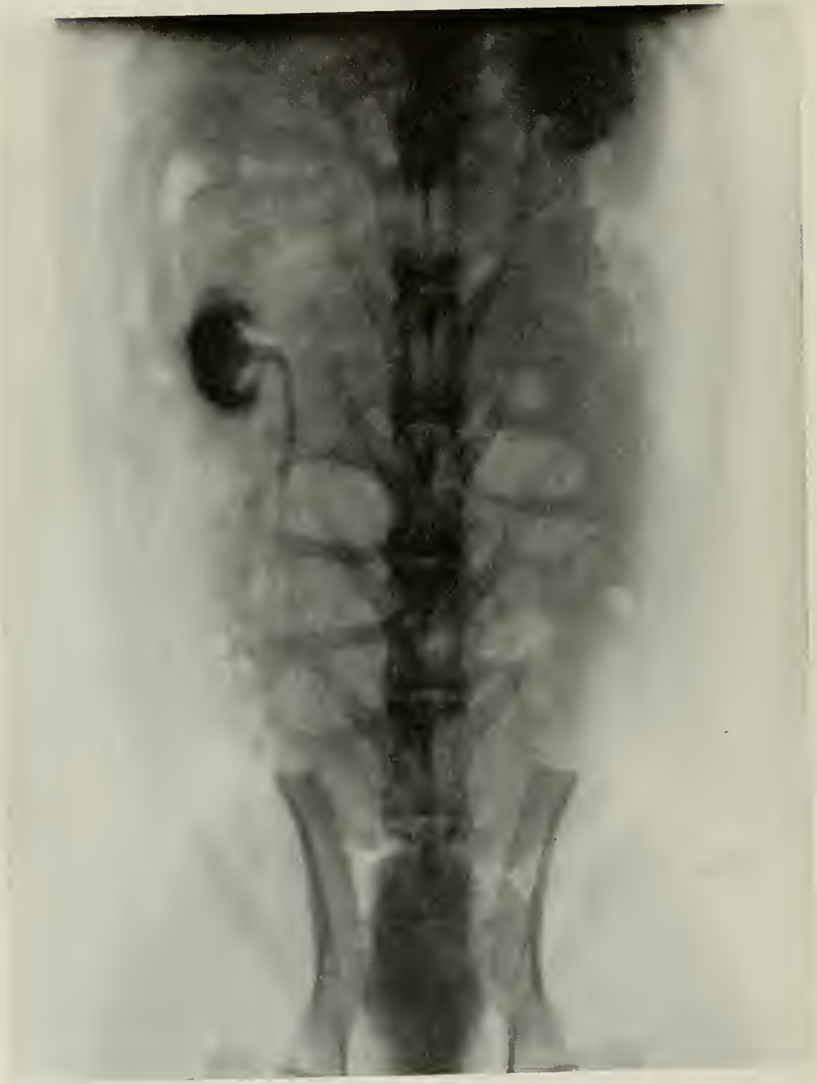

FIG. 5. BILATERAL PYELOGRAM MADE IN A NORMAL INTACT UNANESTHETIZED RABBIT THROUGH REGURGITATION OF VESICAL CONTENTS (25 PER CENT SODIUM BROMID SOLUTION)

The phenomenon was witnessed through the fluoroscopic screen

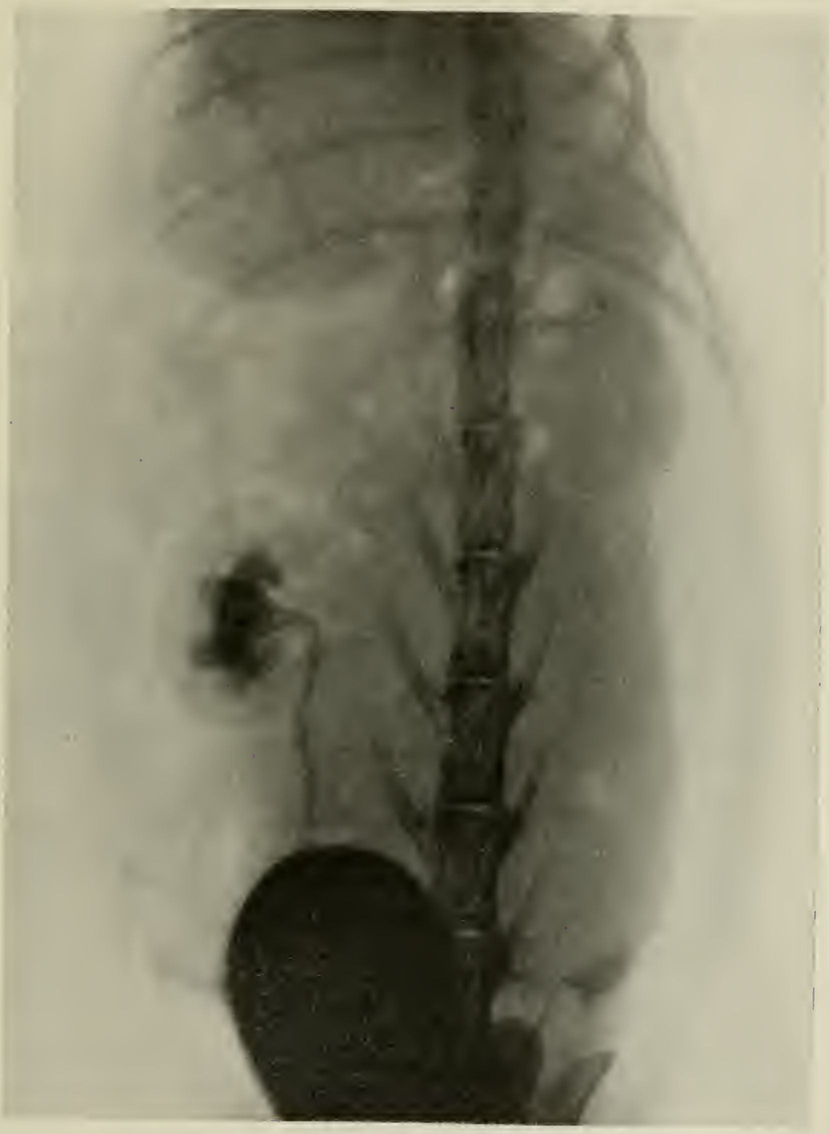

FIG. 6. PYELOGRAM MADE THROUGH REGURGITATION OF VESICAL CONTENTS (25 PER CENT SODIUM BROMIDE SOLUTION)

The animal was normal, intact and essentially unanesthetized exposed X-ray films for the sake of obtaining permanent records (figs. 5 and 6). At the close of each experiment laparotomy was performed under general anesthesia in order to confirm our findings. Six of 11 cases studied by this method showed unmistakable regurgitation under the fluoroscope.

X-ray experiment 11. Male rabbit; 2.5 kgm. April 14, 1922. Morphia $\frac{1}{8}$ grain. Bladder emptied of 3 to 4 cc. of urine. Catheter tied in position. Animal placed on X-ray table. Bladder slowly filled with warm solution of 25 per cent sodium bromid (colored with India ink). Vesical outline well defined fluoroscopically. With 34 cc., pressure 26 mm. Hg.; bilateral regurgitation clearly seen.

Catheter clamped and abdomen opened after ether anesthesia. Bladder found firm, small and perfectly intact. Both ureters filled with black fluid.

Note: The chief interest in the experimental study of regurgitation of vesical contents lies, of course, in its bearing upon ascending infections of the urinary tract. The fate of particulate matter carried to the kidney by means of reflux, as an analogy to the distribution of bacteria, becomes, therefore, of extreme importance. In a large number of our experiments we made use of suspensions of India ink in the fluid to be used for bladder filling, and after regurgitation occurred, studied grossly as well as microscopically the fate of the particles of carbon. Almost invariably the blood stream as well as the distant organs, such as the lungs, liver and spleen, were found to harbor generous quantities of black, most abundantly in the free leucocytes and endothelial cells. In the kidneys themselves the distribution was for the most part circulatory or lymphatic. The path of entrance from the pelvis into the renal parenchyma and into the circulation beyond, we have thus far been unable accurately to determine. In only 1 or 2 cases out of a group of some 40 experiments did we see carbon particles in the collecting or convoluted tubules.

We soon became convinced that the importance of this phase of the problem and the technical difficulties of its solution were too great to be given mere incidental consideration. We determined, therefore, that the distribution of particulate matter in regurgitation should be studied separately at a later date.

SUMMARY

Because of its bearing upon ascending types of renal infection, regurgitation of vesical contents has been made the subject of a special study.

The anatomy, pharmacology and physiology of the ureter have been reviewed, together with the work of other investigators upon the problem of reflux.

The occurrence of regurgitation was first studied in 73 normal rabbits, the bladders of which were slowly filled with warm physiological salt solution. The phenomenon was observed in 73.7 per cent of these cases. In this series attention was particularly concentrated upon the relation of the bladder to reflux.

In a second group of animals, the ureters had been rendered abnormal by previous operative procedures. Regurgitation was produced in 78.7 per cent of the attempts. These experiments afforded an opportunity to study especially the rôle of the ureter.

Several animals were subjected to complete urinary obstruction for the purpose of producing regurgitation as a result of prolonged retention.

In a final series reflux was studied in the intact animal, and the phenomenon was witnessed through the fluoroscope in 6 of 11 experiments.

CONCLUSIONS

The work which forms the basis of this communication emphasizes again that regurgitation is an experimental fact. The conditions that favor its occurrence, however, have been less well understood, and it is with these that we were particularly concerned. In the case of normal rabbits we found that the ease with which regurgitation occurred depended on a variety of factors. Chief among these was good bladder tone which seemed to be indispensable. We learned, for example, that those bladders which were relatively empty and contracted at the beginning of the preparation produced reflux twice as frequently as those which had been recently distended with large amounts of urine. Moreover, we were soon able to predict the outcome of the experiment by observing whether the bladder wall rounded itself in active resistance to distention or was becoming filled passively like a toneless sac. Active pressure usually caused regurgitation; passive pressure never.

In the series in which the ureters had been rendered abnormal, reflux occurred just as frequently as with normal structures; and in the cases where one ureter alone was disturbed the occurrence of regurgitation did not differ in its essentials on the two sides. We conclude, therefore, that the degree of ureteral activity has relatively little bearing upon regurgitation.

We have never seen antiperistalsis in a normal ureter and in no way have we found it concerned with regurgitation.

In spite of experimental difficulties, we have seen reflux occur as a result of acute urinary obstruction.

We have demonstrated, finally, that regurgitation of vesical contents into the ureter may be observed in the normal, intact, unanesthetized subject.

Upon the basis of this work we believe that bladder regurgitation may be accountable for ascending infections of the urinary tract, particularly in cases of vesical-neck obstruction.

In subsequent papers we will discuss the effects upon reflux of variation in the type, reaction, tonicity and temperature of the fluid used in bladder fillings, together with the result of changes in the rapidity of distention. Experiments with other animals, cats and dogs, will also be reported, as will our further clinical investigations.

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THE RELATION OF THE BOWEL TO B. COLI KIDNEY INFECTIONS[1]

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In view of the preponderance of B. coli in infections of the bladder and kidney, much speculation has arisen as to the source of the organisms found in the urine and as to the channels by which the organisms reach the urinary tract. The vagina and neighboring structures have been suspected as the source of the B. coli in so-called ascending infections as well as the bowel, which has been regarded for many years as the probable source of the colon bacillus, from whence the organisms may reach the urinary tract by way of the blood stream or by direct lymphatic connection between the bowel and kidney. The choice of these routes largely depends on the enthusiasm of the writer. The literature on the subject is large and many times contradictory. To instance an extreme position, one writer has recently advocated giving large doses of methylene blue to fill the lymphatic spaces of the bowel with the purpose of killing the organisms before they reached the kidney. A great amount of painstaking clinical investigation as well as careful experimental work has been done on this and allied problems and a short resumé will be given of some of the more important contributions which have to do with the relation of the bowel to blood stream infections by the colon bacillus as well as to the spread of B. coli from the bowel to the kidney by the way of the lymphatics.

The following outline presents the subject as it will be discussed:

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[1] Read at the Chicago Pathological Society, December 11, 1922.

1. *Clinical evidence of the relation of the bowel to the kidney infections.*
    - A. B. coli blood stream infections in bowel disturbances.
    - B. Pyelitis in diarrhea or gastroenteritis.
    - C. Kidney infections and constipation.
    - D. Urinary tract infections in gross lesions of the bowel.
2. *Anatomical and pathological considerations.*
    - A. Lymphatics of the large bowel.
    - B. Presence of intestinal bacteria in the organs of the body.
    - C. Passage of pigment and tubercle bacilli through the normal bowel wall.
    - D. Evidence favoring passage of other bacteria through the normal bowel wall.
    - E. Evidence that bacteria only pass through pathological bowel wall.
3. *Authors' experiments on dogs.* Bacteriological study of mesenteric glands, chyle, bile, blood, right kidney urine, left kidney urine, bladder urine in:
    - A. Control animals.
    - B. After injection of small amounts of B. coli into the dogs' stomach.
    - C. After injection of large amounts of B. coli into the dog's stomach during fat digestion.
    - D. After constipation by opium.
    - E. After prolonged catharsis.
    - F. After partial obstruction of bowel.
    - G. After traumatism of the bowel.
    - H. After injection of B. coli into mesenteric glands.

1. CLINICAL EVIDENCE OF RELATION OF THE BOWEL TO KIDNEY INFECTIONS

A. B. coli blood stream infections in bowel disturbances

Dumas and Menard (1) made blood cultures in 8 cases of diarrhea in infants and found B. coli in one patient's blood and paracolon bacillus in another.

Ten Broeck (2) examined 14 cases dying of infective diarrhea. In 4 of these patients having ulcerative colitis and in 1 having membranous colitis, he isolated B. coli from the blood stream. In 5 others he grew B. coli from the mesenteric glands (3 ulcerative colitis, 1 membranous colitis, Shiga follicular colitis). Postmortem examinations were held one to two hours after death.

Bahr (3) found organisms, mostly B. coli, in the blood in 115 cases of bowel disturbance. Sixty of these findings were during life and 55 positive cultures from the blood were obtained postmortem.

Kowitz (4) in 40 cases of pyelitis in children under two years of age, all of whom had digestive disturbances, found B. coli in the blood stream in 1 infant during life and in 2 one-half hour after death.

Heitz-Boyer (5) reports 3 cases of pyelitis in which he isolated B. coli from the blood stream and thought the origin was intestinal because, as he naively states, the disease was healed by small doses of castor oil.

B. Pyelitis in diarrhea and gastroenteritis

Kowitz (6) reports 40 cases of pyelitis, 92 per cent due to B. coli, in all of which digestive disturbances were present. Most cases of pyelitis in children occur in July to November corresponding to the period of summer diarrhea.

Meyer had 68 cases of pyelitis in children in whom primary bowel disturbances were present in 44.

Friedenwald had 80 cases of pyelitis in children, of whom 59 had bowel disturbances.

Jeffreys (7) reports 121 cases of pyelitis, of whom 34 had definite evidence of bowel disturbances.

Czerny and Moser (8) believe severe gastroenteritis is a disease with general infection, spreading from the bowel through the blood stream and often causing urinary infection.

Herbst (9) reported a bilateral B. coli pyelitis in a woman suffering from colitis.

Morse and Crothers (10) examined the urine of 300 cases of gastroenteritis and said infection of the urinary tract was common but gave no figures.

Knox and Meakins (11) found a pyuria in 15 of 53 children varying from three months to two years in age, suffering with gastroenteritis.

Wilson (12) emphasized the occurrence of pyelitis in infants under two years of age, following diarrhea.

Trumpp (13) found B. coli in the urine of 14 children with follicular enteritis of 17 examined.

C. Kidney infection and constipation

MacGowan (14) states that colonic stasis is important in the continuation of symptoms in B. coli infections of the urinary tract, assuming that the bowel organisms enter the circulation to gain the kidney or travel by the lymphatics from the bowel to the kidney. He believes that pyelitis under such conditions is incurable until the large intestine is freed of adhesions or other lesions by appropriate surgical measures. He reports 2 cases which he believes illustrate his contention; one being a fecal impaction, which upon being relieved resulted in a speedy regression of the pyelitis.

French (15) believes that B. coli reaches the kidney through the blood stream from the bowel during constipation.

Williams (16) examined the urine of 70 unselected cases for B. coli. In one group of 44 women suffering from constipation (11), or diarrhea (5), 16 were found to have B. coli in the urine. In the other group of 26 women having no intestinal disturbance, the urine was sterile. In the affected patients improvement of the bowel condition was followed by disappearance of the organisms from the urine.

Lindermann emphasizes the relation of intestinal lesions, as constipation, in 17 of his 48 cases of pyelitis of pregnancy.

Heitz-Boyer believes that functional disturbances of the bowel, as constipation, are responsible for B. coli infections of the kidney. He does not indicate the route the organisms take to reach the kidney except where blood stream infections are known to have been present.

Dudgeon (17) found B. coli in the urine with pyuria in 2 of 20 cases of chronic constipation examined.

D. Urinary tract infections in bowel lesions

Heitz-Boyer reports a pyelitis coming on with a volvulus and another with a chronic appendicitis. He calls them enterorenal disease.

Dudgeon (18) has found B. coli in the urine without pyuria in 20 cases of acute and subacute peritonitis.

Hutchinson (19) believes B. coli may pass from the bowel to the kidney by the lymphatics where lesions of the bowel are present and quotes a case where an appendix was adherent to the kidney and B. coli was found in the urine.

2. ANATOMICAL AND PATHOLOGICAL CONSIDERATIONS

A. Lymphatics of the large bowel

Hyrtl and Cruveilhier (20) and others have described the lymph channels of the large bowel as passing into nodes in the mesial sheath of the mesentery and from thence to the lumbar glands and thoracic duct. The large bowel has fewer and smaller lymphatics than the small bowel.

Franke (21), (22) studied the lymphatics of the cecum and ascending colon by the injection method of Gerota, using Prussian blue. His material consisted of 27 babies dying at birth or shortly after. In specimens in which a partial union of the posterior surface of the bowel with the kidney was present, he was able to demonstrate lymph vessels running onto the capsule of the kidney from the bowel. This was demonstrated in 5 specimens, or in about 20 per cent of the bodies examined. In 1 case the tip of the appendix was adherent to the kidney and a similar lymphatic communication was injected.

In 3 instances one or two lymph vessels were injected on the ascending colon which ran from the surface of the kidney under the mesocolon retroperitoneally to the lumbar glands. In conjunction with this work, Franke speaks of its significance in the development of perinephritic abscess after typhoid or appendicitis and in the spread of bowel tuberculosis to the kidney.

Starr (23) by microscopic study and injection methods demonstrated the connection between the lymphatics of the capsule of the kidney and the parenchyma of the kidney which in turn communicates with the pelvis of the kidney by lymphatic channels. He also showed that the lymphatics of the pelvis and cortex drained into the lumbar nodes.

Franke (24) administered 0.05 gram of opium to rabbits for four to five days and found bacteria in the mesenteric glands which he thought was positive evidence that these organisms could reach the kidney by way of the lymphatics.

B. Presence of intestinal bacteria in the organs of the body

Welch (25) was able to find B. coli in one or more organs at autopsy in 33 cases of 200 examined. In all of these 33 subjects, some intestinal lesion was present.

Adami (26) and his co-workers in a study of normal and cirrhotic livers found numerous diplococcoid bodies which were thought to be attenuated forms of B. coli. He intimates that it is usual for organisms to get into the blood stream from the normal intestine and find lodgment especially in the liver and kidney.

Ford (27), a co-worker with Adami, studied the bacterial content of healthy organs by removing aseptically kidneys and livers of rabbits and after searing the surfaces of the organs, dropping them into gelatin and every few days aspirating some of the tissue through a pipette for culture. He was able to grow staphylococci and B. coli in 66, or 85 per cent, of the attempts. He also used the organs of cats and dogs as well as human organs. Of 93 organs examined, 77 per cent contained organisms which were grown on media. In the dog, no B. coli or paracolon bacilli were grown. In all of these experiments, the cultures were sterile at the end of three days and it was only after incubation of the organs longer than this period that bacteria were grown.

Wurtz and Herman examining the organs of 32 cadavers dead of tuberculosis, found B. coli in the liver 15 times, in the kidney 12 times and in the spleen 6 times.

Ackard and Phulpin studied 49 cases in their death agony or directly after death and found organisms in the blood stream or in organs in 10 cases.

C. Passage of pigment and tubercle bacilli through the normal bowel wall

Ravenel (28) introduced tubercle bacilli mixed with a butter emulsion into the stomach of dogs. The dogs were killed in eight hours and chyle and mesenteric glands taken from them for injection into guinea pigs. In 8 of 12 experiments, tuberculosis developed in the guinea pigs so injected. Ravenel quotes Chouveau, who in 1868 said young cattle could become tuberculous by ingesting tubercle bacilli.

Nicholas and Decos found that tubercle bacilli, fed to dogs, were found in the chyle in three to four hours. Von Bekring, Römer and Besanti and Pauisset have reported the same findings. Schlossman and Engle repeated the work in other animals with the same results.

Calmette (29) injected into the stomach of adult animals 20 grams of a fresh culture of tubercle bacilli, finely titurated and diluted in water. Tuberculosis of the mesenteric glands, and in young animals pulmonary tuberculosis, developed.

Griffith (30) fed chimpanzees bovine tubercle bacilli by mouth and found that ulceration of the intestine, tuberculosis peritonitis and tuberculosis of the mesenteric and cervical lymphatic glands resulted. If a chimpanzee was examined a short time after injection of tuberculous material, the tuberculous organisms were found in the mesenteric glands though the mucosa of the intestine was normal.

Passage of pigment through the bowel wall. Calmette, Vansteenberghe and Grysez (31) fed powdered coal and china ink or injected the same into the stomachs of animals. They observed that adult animals developed an anthracosis of the lungs in twenty-four to forty-eight hours but that in young animals, the mesenteric glands were pigmented and the lungs escaped pigmentation. If one lung was occluded by a cotton plug in the bronchus and the animals allowed to inhale air laden with carbon, the pigment was found in the *bronchi* of the unobstructed lung and in the *parenchyma* of the obstructed lung where it has been deposited by the lymphatic stream from the intestine.

Arbeiter (32) says these facts were in the main observed by Osterlen in 1846 and by Claude Bernard in 1853.

Cobbett (33) in a critical review of the whole subject, accompanied by experimental work of his own, believes that the presence of thread worms in the intestinal tract of laboratory animals is responsible for small lesions which allow bacteria to pass through the bowel wall. He repeated the Calmette experiments with carbon inhalation and believes that the animals used were living in manufacturing towns and already had anthracosis of the lungs. In his feeding experiments with tuberculosis, he doubts whether more than a mesenteric gland tuberculosis will result unless the intestine is damaged as it was in the experiments by Ravenel and Reichel (34), and Oberwarth and Lydia Rabinowitsch (35).

D. Evidence favoring passage of other bacteria through the normal bowel wall

Beco (36) believes that B. coli can leave the intestinal tract *after death* where no lesions of the intestine are present and demonstrated B. coli in all layers of the bowel.

Bizzozzero (37) found bacteria in the lymph follicles of the normal intestine of dogs and observed more microörganisms next to the muscle layer than were found in the submucosa. He opened into the lymph follicles from the peritoneal side without getting into the intestinal lumen.

Nocard (38) found many organisms in the chyle of dogs fed on a diet rich in fat.

Desoubry and Porcher (39) found a large number of bacteria passed into the chyle during fat digestion in dogs. They also found numerous bacteria in the blood stream at this time

Rogozinski (40) in 21 of 26 dogs examined found B. coli in the mesenteric glands. After feeding B. prodigiosus, killiensis mycoides in 7 dogs, the organisms were isolated from the mesenteric glands in 5 experiments. He was unable to demonstrate a passage of the organisms through these glands.

Nicols (41) believes he observed a small diplococcus or diplobacillus in the mesentery of healthy rabbits but he did not recover it by culture.

Selter (42) states that organisms may pass through a normal bowel wall and be retained in the mesenteric glands.

Oppenheimer (43) fed B. coli and B. prodigiosis to rabbits and found the organisms in the blood and viscera.

v. Ficker (44) found that where fat is given in food organisms can pass through the bowel during the digestive period. The bowel of young rabbits (3 of 8) allowed organisms to pass through while the same phenomena were absent in grown animals. If animals who have been starved are fed bacteria, they are found in the blood and chyle.

Thiele and Embleton (45) (*a*) injected organisms into the duodenum. The thoracic duct was exposed and its contents cultured. From one to four and one-half hours, the chyle was sterile. (*b*) The duodenum was traumatized in cats and organisms were injected into the bowel. No growth from blood or chyle was obtained up to three hours afterward. (*c*) Bacteria were believed to pass through unimpaired mucosa of the stomach and intestines in some animals and into the chyle and blood. The mesenteric glands did not intercept them or at least were inefficient filters. Huge amounts of organisms must be given to accomplish this result.

E. Evidence that bacteria pass only through pathological bowel wall

Fador (46), Meissner (47) and Hauser (48) found blood of normal animals sterile.

Opitz (49) states that the bowel is a barrier to the passage of organisms during life. He cultured the mesenteric glands from cattle and calves and found them sterile in most instances and does not share the view that organisms pass through intact bowel during digestion.

Bassett and Carre (50) and Loiseleur (51) agree with this view.

Garnier and Simon (52) speak against the passage of organisms through the normal bowel wall. They obstructed the intestine in dogs and found intestinal organisms, mostly anaerobes, in the blood after two or three days. Freezing, overheating, intoxication, all lessen the means of defense and may result in blood stream infections. In rabbits living on an exclusive meat diet, septicemia may develop on the fourth to seventh day when anaerobes were found in the blood.

Ballin, working in the Institute of Hygiene in Berlin, found the blood and viscera sterile after the injestion of fat in young pigs, rabbits, dogs and goats. He fed B. prodigiosus and found the blood and viscera sterile. He himself took B. prodigiosus and his blood cultures remained sterile.

Hornemann (53) fed anthrax and bacillus of hog cholera to young and old rabbits and also to guinea pigs and killed them from four to thirteen hours later. At autopsy he was unable to find the organisms in the viscera or mesenteric glands.

Prodigiosus and staphylococci were fed to animals and these were not found in cultures of the viscera. B. coli was not found in the organs in these experiments.

He believes the bowel is not permeable to organisms under normal conditions but admits that slight variable factors as hyperemia, desquamation of the mucosa, small injuries of the mucosa, as from intestinal worms, irritation from food of different types, or infection may allow bacteria to pass through (Ficker).

Hornemann fed NaF in 0.02 to 0.03 gram doses to animals and found B, coli in the mesenteric glands. He criticizes experiments where large amounts of organisms are fed and injected into the bowel as the toxins may cause damage and instances the effects of B. prodigiosus.

In regard to leucocytes carrying organisms through the bowel, he found only a few leucocytes in the bowel wall where small amounts of anthrax had been fed but increased numbers of leucocytes were present where large amounts of the organisms had been fed. Sections of the bowel wall studied microscopically failed to reveal leucocytes containing the bacillus of anthrax.

He believes that in humans, organisms get into the blood stream from the intestinal tract only when lesions of the bowel are present.

Wyssokowitch in Flügges Göttunger Clinic injected large amounts of staphylococci pyogenes into the bowel and on examination of the mesenteric glands one to four and one-half hours later, found them sterile in most cases. B. coli was found in the exceptions.

Neisser (54) believes that the bowel is impermeable for microorganisms under normal conditions. The author took pieces of bowel wall, not including the mucosa, and cultured them and found them sterile. He fed dogs large amounts of staphylococci in fat and collecting the chyle from the exposed thoracic ducts found the chyle sterile. The organisms used were trained to grow in gastric juice. The mesenteric glands were sterile as well as pieces of overlying chyle duct.

He also repeated these experiments and cultured the organs of the animals and found them sterile.

He fed a series of dogs with ground glass creating a bloody diarrhea and other dogs with NaF and injured the bowel in others with croton oil and then fed the animals different types of pathogenic organisms. In practically all of the experiments, the organs were sterile as were the chyle vessels in the mesentery. He believes a special virulence in the microörganisms is necessary to cause general infection and does not believe the bowel is a common source of general infection.

In attempting to epitomize the work published on this problem and to properly estimate its value, one is brought to face with many conflicting opinions and divergent conclusions. The outstanding facts which are generally accepted are that B. coli is present in from 50 to 80 per cent of urinary tract infections, that the bowel is the natural habitat for that organism, and that B. coli are not commonly found in the so-called focal infections. While it is admitted that ascending infections from the genitalia and neighboring structures may be the mode of infection of the urinary tract in a few instances, it is very doubtful if the majority of the infections arise from that source. That bacteria may gain access to the urinary tract from the blood stream is generally accepted. Franke's work of injection of the lymphatics from the cecum and appendix to the capsule of the kidney in infants has been quoted and referred to so often that little doubt has been expressed as to the rehability of this pathway of infection. In reading Franke's articles on this subject and in studying his drawings of the injected lymphatics between the cecum and the right kidney capsule, the possibility of infection of the kidney by continuity from a diseased appendix or inflamed bowel adherent to the peritoneum over the kidney capsule is obvious. It is questionable, however, how possible it is for infections to travel by the lymphatics from the bowel to the kidney if there be no gross lesion of the bowel or inflammatory process in the bowel which would cause adherence of the bowel to the kidney capsule. It is questionable because the lymphatic vessels between the bowel and kidney capsule are very small, relatively few in number and inconstant. The lymph flow from the intestine and appendix is to the mesenteric glands and not toward the kidney and lastly, it is not definitely known that organisms leave the normal or slightly damaged bowel and gain access to the lymphatics other than the mesenteric glands The presence of organisms in the mesenteric glands is by no means synonymous with kidney infection or with blood stream infection.

The striking work of Ravenel, Calmette and Griffith on the passage of tubercle bacilli and pigment through the normal bowel mucosa makes it seem very probable by analogy that other bacteria might penetrate the normal mucosa of the bowel. Thiele and Embelton, v. Ficker and others have reported experiments which seem to prove the point while Opitz, Tannier and Simon and Neisser in carefully conducted work throw grave doubt on that conclusion.

3. AUTHORS' EXPERIMENTS ON DOGS

With a desire to present further evidence, we have conducted experiments on dogs to study the possibility of the passage of bacteria and especially the colon bacillus, through the normal and pathological bowel wall to the mesenteric glands, to the blood stream or directly into the urinary tract through the lymphatics. Realizing that only a few organisms might reach the urinary tract through the blood stream or lymphatics, and, therefore, be lost without producing lesions or not being isolated by culture at the moment of their passage through the urinary tract, we have ligated and divided the right ureter in a number of dogs before the experimental conditions were established. By this means, a hydronephrosis is produced on the right side.

In some other work we have demonstrated that bacteria in the blood stream are secreted into hydronephrotic kidneys in dogs. Therefore, in these experiments, organisms secreted into the right kidney from the blood stream or gaining access to it by the way of the lymphatics would have a favorable culture medium in the urine of the hydronephrosis in which to multiply.

In obtaining material for culture, the abdomen was opened with the same surgical care and technique used in performing laparotomies in the human. The tissue cultures of the mesenteric glands, kidney and liver were made by putting the material through a sterile Rosenow grinder and using the tissue emulsion in ascites bouillon and ascites agar for culture. Heart's blood was used for blood culture. Control urine by aspiration from the bladder was obtained, by previous laparotomy in practically all of these experiments and all dogs with organisms in the urine were excluded from the experiment.

a. Control experiments

1. Three dogs with distemper laparotomized under sterile conditions. Tissue culture of mesenteric glands:

B. coli present	1
Gram positive diplococcus present	1
Sterile	1

Cultures of heart's blood, bile, bladder urine, right kidney urine, left kidney urine were all sterile except one right kidney urine from which a few colonies of staphylococcus were grown. In two dogs, intestinal worms were present.

2. Three dogs examined during digestion.

B. coli present	1
Gram positive bacilli present	1
Sterile	1

The chyle taken from the chyle vessels in the mesentery and from the thoracic duct was sterile in all three dogs. The bile, heart's blood, right kidney urine, left kidney urine and bladder urine were sterile. No intestinal worms were present.

3. Three additional control dogs. Tissue culture of mesenteric glands:

B. coli present	1
Sterile	2

Bile, heart's blood, right kidney urine, left kidney urine and bladder urine were sterile except one bladder urine which contained B. coli. In this dog the mesenteric glands were sterile. Intestinal worms were present in one dog.

Summary of nine controls. Tissue culture of mesenteric glands:

B. coli present	3	55 per cent
Other bacteria present	2	
Sterile	4	

Chyle, heart's blood, urine from each kidney and bladder were sterile except in one dog with B. coli in the bladder urine and in another dog with a few staphylococci in the right kidney urine. In both of these dogs, the mesenteric glands were sterile.

Organisms are seldom present in the urine of dogs living under normal conditions. In another series of controls where this question was considered, only 2 of 45 dogs had organisms in their bladder urine (55).

Intestinal worms were found in the intestinal tract in three dogs, one of whom had sterile mesenteric glands and sterile cultures from blood, bile and urine. Postmortem examination revealed normal intestines and urinary tract in all of the animals.

B. Small amounts of B. coli in broth injected into the stomach through a stomach tube

A test tube full of a twenty-four hour broth culture of B. coli was injected into the dog's stomachs through a small tube. Six dogs were laparotomized from twenty-four hours to seven days after the beginning of the experiment. Control urine was obtained and in some instances ligation of the right ureter was performed at a previous laparotomy.

Tissue culture of mesenteric glands:

B. coli present	3	66 per cent
Staphylococcus present	1	
Sterile	2	

Bladder urine, right kidney urine, left kidney urine, heart's blood and bile were sterile in all six dogs.

Macro- and microscopic examination of the kidneys and especially the right kidney including the capsule were negative for inflammatory exudate. The intestinal tract was negative in all. None of the six dogs had intestinal worms.

Summary. Small amounts of actively growing colon bacilli injected into the stomach of dogs has no appreciable effect in increasing the bacterial content of the mesenteric glands, the blood stream or the urinary tract.

C. Injection of large amounts of B. coli into the stomach of dogs during fat digestion

From 100 to 300 cc. of a twenty-four hour bouillon cultures of B. coli were injected into the stomachs of 11 dogs and at the same time 3 or 4 ounces of Mazola oil was put into the stomach through the same stomach tube. Four dogs were examined during fat digestion, 4 dogs from two to fourteen days after the injection and 3 dogs, sick with distemper and diarrhea, were examined from three hours to sixteen days after the injection of the B. coli.

1. Four healthy dogs, laparotomized during fat digestion, two to three hours after injection of B. coli and fat. Tissue culture of the mesenteric glands:

B. coli present	2
Staphylococci present	1
Sterile	1

Tissue culture of the liver was sterile in two dogs. Tissue culture of the right kidney in one dog showed B. coli and B. coli was isolated from the urine of the hydronephrosis. The mesenteric glands in this dog contained staphylococci. The bile, right kidney urine, left kidney urine and heart's blood were sterile in all others.

2. Four dogs kept on a rich fat diet, laparotomized from two to fourteen days after injection of B. coli. Tissue culture of mesenteric glands:

B. coli present	3
Sterile	1

The bile, heart's blood, tissue culture of liver and right kidney as well as the right kidney urine, left kidney urine and bladder urine were sterile.

3. Three sick dogs were examined three to forty-eight hours after injecting into their stomachs 100 to 300 cc. of broth culture of B. coli and fat. In the dog afflicted with distemper and posted forty-eight hours after the beginning of the experiment, tissue cultures of the mesenteric glands, right kidney and liver were sterile as were also the cultures of bladder urine, right and left kidney urine, bile and heart's blood.

In the second dog afflicted with distemper and diarrhea, posted three hours after the injected of B. coli and fat, the tissue cultures of the right kidney and liver were sterile as were the heart's blood, bile and urine from the right and left kidney. The bladder urine contained B. coli but the tissue cultures of the mesenteric gland contained staphylococci.

The third dog, sick and emaciated, was given 4 ounces of a broth culture of Flexner bacillus which had been isolated from a case of pyelitis. This dog was posted in twenty-four hours. From the mesenteric glands, B. coli was grown and from the right kidney a Gram negative bacillus which was not a gas producer or dextrose and which did not acidify nor coagulate milk, was isolated. All other cultures of blood, bile and bladder urine were sterile.

Summary. 1. In these 11 dogs, which had been given large amounts of B. coli with fat by stomach tube, 8 were found to have organisms in the mesenteric glands, 6 of which were B. coli.

2. Three dogs of this group were found to have Gram negative bacilli in the bladder urine, kidney urine or kidney tissue. The

mesenteric glands contained organisms in all of these 3 animals but in none were the same organisms found in the glands as were present in the urinary tract.

3. No instance of blood stream infection on injection of the bile or liver was found.

4. In 2 very sick dogs, the urinary tract contained Gram negative bacilli under the experimental conditions. Here also the mesenteric glands contained organisms but not those found in the urinary organs.

5. The incidence of organisms in the mesenteric glands was slightly higher than in the control animals but not sufficiently so as to draw definite conclusions.

6. The incidence of oganisms in the urinary tract was much higher than in control animals and was striking because of the negative urine in these animals before experimental conditions were established. Whether the B. coli grown from the kidney tissue were present before the experiment started is difficult to say. That the organisms did not reach the kidney by the lymphatics from the bowel is fairly certain because the mesenteric glands contained organisms of another type than those found in the kidney substance.

7. Intestinal worms apparently play a minor rôle in allowing organisms to penetrate the bowel wall. Worms were present in the intestinal tract of four dogs having organisms in the mesenteric glands but were also present in 1 dog having sterile mesenteric glands and were absent in 2 dogs having organisms present in the mesenteric glands.

D. Effect of marked constipation

Two dogs were constipated for thirteen and fifteen days respectively by the administration of opium and were given B. coli into the stomach by a stomach tube. Tissue cultures of the glands were sterile in 1 dog and contained some Gram positive bacilli in the other. The bladder urine, right and left kidney urine and heart's blood were sterile.

Summary. Very marked constipation even associated with injection of B. coli into the gastrointestinal tract was not associated with increased bacterial content of the mesenteric glands or with infection of the urinary stream.

E. Effect of prolonged diarrhea coupled with the administration of large amounts of B. coli by stomach tube

Three dogs were given a severe diarrhea which was bloody in 2 of the dogs, for a twelve days period by administration of compound cathartic pills Tissue culture of the mesenteric glands:

B. coli present	2
Sterile	1

The bladder urine, right and left kidney urine and blood were sterile in all three animals.

Summary. Prolonged and severe diarrhea was not associated with infection of the urinary organs or with an increased bacterial flora in the mesenteric glands even though large amounts of B. coli were introduced into the intestinal tract.

F. Effect of obstruction of the bowel coupled with the administration of large amounts of B. coli by stomach tube

In 6 dogs, the colon at the ileocaecal valve or at the sigmoid was constricted by fascia. The animals were posted on the third day. The mesenteric glands by tissue culture:

B. coli present	5
Staphylococci present	1
Sterile	0

The blood, bladder urine, right and left kidney urine, bile and chyle were sterile in all.

Summary. Obstruction of the large bowel raises the incidence of bacteria in the mesenteric glands very materially. In no experiment did urinary tract infection accompany it. This emphasizes the fact that the presence of intestinal organisms in the mesenteric glands is not synonomous with blood stream infection or urinary tract infection.

G. Bowel traumatized by needling or injection of turpentine accompanied by injection of large amounts of B. coli into the gastrointestinal tract by stomach tube

Four dogs were posted on the seventh day after the traumatism of the bowel. Tissue culture of the glands:

B. coli present	3
Gram positive bacillus	1
Sterile	0

The bile, blood, bladder and kidney urine, and chyle were all sterile except in one dog where staphylococci were found in the bladder urine though B. coli were present in the mesenteric glands.

Summary. Traumatism of the bowel is associated with higher percentage of bacterial content of the mesenteric glands than in control dogs. Urinary tract infection was absent. In these experiments of obstruction of the bowel and traumatism of the bowel, the mesenteric glands contained B. coli in eight of ten dogs. If a lymphatic connection between the large bowel and the kidney capsule were really a factor in supplying a pathway for the spread of the infection from the bowel to the kidney, it is significant that no B. coli urinary infection was present in any of these experiments. It is equally significant that if organisms reached the blood stream from the mesenteric lymph glands, they did so in such small numbers that they were destroyed in the blood stream before being secreted in the kidney urine. In our experiments the ligated ureter and developing hydronephrosis on the right side would simulate conditions of partical obstruction in the human because of ptosis of the kidney, kinks and valves on the ureter, stone, etc., which by reason of stasis of urine predispose to urinary infection of organisms reaching the urinary stream.

H. Implantation into the mesenteric glands of gauze saturated with B. coli or injection of B. coli into the mesenteric glands

Four dogs were posted from two to ten days after the experiment. B. coli were present in the mesenteric glands in all 4 dogs but bile, chyle, bladder and kidney urine and blood were sterile.

Summary. Actively growing B. coli in the mesenteric glands is not necessarily associated with blood stream infection or urinary tract infection and negatives the probability of infection of the kidney by the way of the lymphatics from the bowel. In these experiments bacteria implanted in the mesentery or glands were isolated from the mesentery and mesenteric glands several days after their implantation and yet no urinary tract infection resulted.

CONCLUSIONS

1. In control dogs with normal intestines, the mesenteric glands contain bacteria in over 50 per cent and contain B. coli in 33 per cent of the glands examined. These facts speak conclusively for the passage of organisms from the normal bowel to the mesenteric glands.
2. Injection of large amounts of actively growing B. coli into the normal gastrointestinal tract of dogs was associated with the presence of B. coli or a B. coli-like organism in the urinary tract in three of 11 dogs. It is probable that these organisms reached the urinary tract by way of the blood stream. The lowered resistance of the animals afflicted with distemper seemed to predispose to infection of the urinary tract.
3. Moderately prolonged constipation or diarrhea in dogs was not associated with relative increase of organisms in the mesenteric glands or with urinary tract infection.
4. Obstruction of the large bowel or traumatism of the bowel is associated with an increased bacterial content of the mesenteric glands and urinary tract infection occured in 1 dog.
5. No evidence was forthcoming that organisms reaching the mesenteric glands from the bowel tended to involve the urinary stream by way of the lymphatics. It is probable that Franke's hypothesis in this connection would apply only to those instances where a diseased bowel or appendix was in contact with the peritoneum overlying the kidney. This explanation obviously would not include the great majority of kidney infections.
6. Intestinal worms seem to play a minor rôle in effecting the passage of microörganisms through the bowel.

7. Cultures of liver tissue, bile and heart's blood were uniformly sterile and lead one to believe that organisms leaving the normal intestine do so in small numbers and are at most but transcient inhabitants of the blood or liver tissue.

8. The significance of the passage of intestinal organisms through normal as well as pathological bowel wall to the mesenteric glands cannot be overlooked. While it is undoubtedly true that these organisms reach the blood stream in but relatively small numbers and inconstantly, it is nevertheless possible that increased virulence of the organisms, lowered resistance of the host as well as actual lesions of the bowel wall would greatly increase this number of organisms reaching the blood stream. The conclusion would accord with the clinical relation between gastrointestinal lesions and urinary tract infections.

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AN ANTISEPTIC PYELOGRAPHIC MEDIUM[1]

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The work of previous authors, particularly that of Cameron (1), and that of Graves and Davidoff (2), has established the fact, we believe, that sodium iodide is the best available pyelographic medium, because this substance, in 12 per cent solution, possesses an excellent degree of opacity to the roentgen ray, is not irritating when applied to mucous membranes, and is not toxic when introduced in large amounts into the circulation.

It is inexpensive, easily prepared, and sterilizes without difficulty. The viscosity of sodium iodide solution is essentially that of water, and its reaction is practically neutral. Furthermore, the ill effects of hypertonicity, an undesirable feature in some of the commonly employed media, especially sodium bromide, are reduced to a minimum. It lacks but one important quality—that of germicidal activity.

The advantages of an antiseptic pyelographic medium are obvious, but up to the present time no such solution has been available. The ideal substance must possess all the necessary features noted above, and at the same time that of antiseptic action.

In selecting a germicidal substance, our effort has been to take into consideration all germicides of common and ready access, and by a process of elimination to determine the one or several which would be most satisfactory. We have judged that the acceptable material must be stable, and so strongly antiseptic that the requisite amount of it will have no material effect on the concentration and tonicity of the medium. It must, of course, be neither irritating nor toxic.

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[1] Read before the American Association of Genito-urinary Surgeons, Cleveland, Ohio, May 17, 1923.

Inasmuch as 12 per cent sodium iodide has been offered as the most satisfactory pyelographic solution, it has been our effort to choose an antiseptic substance which would be miscible with it.

Colloidal antiseptics, such as argyrol, collargol, and colloidal silver chloride and iodide, are out of the question for colloids are precipitated by electrolytes, and would not remain in solution in the presence of 12 per cent sodium iodide.

Silver salts, so frequently used in the kidney and bladder, (silver nitrate 16)[2] yield with sodium iodide a precipitate of silver iodide more sparingly soluble even than silver chloride. Silver iodide is but slightly soluble in the solution under consideration, only 0.1 per cent concentration being possible in 12 per cent sodium iodide. This combination might have germicidal properties, but it becomes turbid from precipitation when diluted with water, and we have not investigated it further, on this account.

Oxidizing germicides, such as potassium permanganate (42), hydrogen peroxide, alphozone (succinic acid peroxide), Dakin's solution, hypochlorites (146–220), chloramine T. and dichloramine T., liberate iodine from the sodium iodide. They would be no better, therefore, than iodine itself. Iodine water (100) is a fairly vigorous germicide, but its potency is relatively low.

Phenol (1) is entirely too caustic and too toxic. While cresole (3.7) is less irritating and poisonous, it is still too feeble, as are also other phenols, such as guaiacol (0.9), resorcine (0.3), and pyrogallic acid (0.2). Bechhold and Ehrlich (3), have studied the effect of the introduction of halogens into the phenols, and find that one molecule of pentabromphenol has the same effect upon the diphtheria bacillus as 500 molecules of phenol itself. The effect of the halogen is still further magnified if methyl groups are also present; thus, tribrom-m-xylenol is 20 times as powerful as tribromphenol. Bechhold and Ehrlich state further that one halogen reduces and that more halogens increase the toxicity of the disinfectant. A methyl group, on the other hand, counteracts the tendency toward increased toxicity. Tetrabrom-o-cresole, which these authors say is perfectly inocuous, prevents the growth of the diphtheria bacillus in concentrations of 1:200,000, while a solution of 1 part of phenol in 800 is necessary to produce the same effect. Had not some other better known and more accessible substance proved suitable, tetrabrom-o-cresole would merit consideration for our purpose. It is not now listed in any of the American catalogues of pharmacological products, and therefore is eliminated.

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[2] The numbers given after the names of germicides are the Rideal-Walker carbolic acid coefficients (B. typhosus) as reported by Geoffrey Martin, "Indust. and Manf. Chem.," London, Lockwood, 1918, vol. 11.

With the exception of mercury compounds, the other common germicides are too feeble for our use; hexamethylenetetramine, acetylsalicylic acid, salicylic acid, phenylsalicylate, benzoic acid (5.0), iodoform, formaldehyde (0.5 to 0.7), zinc chloride (1.15), boric acid (less than 0.1), etc.

Mercuric salts are the most powerful of the usual germicides (mercuric chloride 400 to 3000). All of them, on treatment with sodium iodide solution, yield bright scarlet mercuric iodide, which is sparingly soluble in water, but which dissolves readily in sodium iodide to form a stable colorless solution of the complex double-salt: Na_2HgI_4. The poisonous action of mercuric salts, and the caustic effect of corrosive sublimate have been ascribed to the mercuric ion, following which belief certain organic compounds of mercury in which the mercury is in the un-ionized state, have come into use as germicides. Mercurochrome 220, a dyestuff of the phthalein series, containing mercury in its molecule, has found much favor and is non-irritating to delicate mucous surfaces, in relatively strong concentrations. We find that a 1 per cent solution of mercurochrome 220 in distilled water does not contain mercury ions, for it fails to amalgamate a copper coin after several hours of contact. When sodium iodide is added, however, this situation no longer obtains, and mercuric iodide results. It is to be supposed that mercuric disuccinimide will behave in the same way. All of these compounds give the same solution that mercuric iodide alone would yield with sodium iodide, and mercuric iodide is the only compound of mercury which can be considered.

Mercuric iodide unjustly enjoys a somewhat evil reputation because of the unpleasant circumstances which ensue when certain mercuric compounds are brought together with iodine or iodides in the same patient. The first degree burn, which is produced when gauze, moistened with corrosive sublimate, is allowed to rest on a cutaneous surface, painted with tincture of iodine, is not due to iodine, to corrosive sublimate, or to mercuric iodide, but to chloride of iodine, produced by the reaction $HgCl_2 + 2\ I_2 = HgI_2 + 2\ ICl$. Chloride of iodine is a very vigorous reagent, which will attack many organic substances not affected by iodine alone, and it is prepared frequently for that purpose in the laboratory by the addition of iodine to a solution of corrosive sublimate.

In the familiar pharmacological experiment in which calomel paste introduced into the eye of an animal which has been fed with iodides, produces a corneal ulcer, the effect is not due to mercuric iodide, but to actual metallic mercury deposited at the point where the calomel rests: $2\ HgCl + 4\ NaI = Na_2\ HgI + 2\ NaCl + Hg$. The incompatibility of mercurous iodide (the yellow iodide) with soluble iodides, is due to the same cause: $2\ HgI\ 2\ NaI\ Hg\ Na_2Hg\ I_4$.

Geoffrey Martin (4), says that mercuric iodide is less irritant to wounds than mercuric chloride, and does not coagulate albumen in the same manner. Hence it has been incorporated into several ointments and soaps. Macfarlan (5) reports the use of a 1 per cent aqueous solution of potassium iodide-mercuric iodide double salt on mucous membranes, and states that 5 drops of the 1 per cent solution were taken internally without injury. Park (6) gives the following table in the comparative review of antiseptic germicidal strengths:

Phenol	1:333
Calcium hypochlorite	1:1000
Silver nitrate	1:12,500
Mercuric chloride	1:14,300
Mercuric iodide	1:40,000

Mercuric iodide as an antiseptic has high potency and can be combined with 12 per cent sodium iodide in great dilution without destroying its gemicidal value. Furthermore, the solution as a pyelographic medium remains essentially unchanged so far as its physical characteristics are concerned. Sodium mercuric iodide is quickly prepared and it forms a stable compound. It is also noteworthy that the iodine content of the medium is made even greater than in 12 per cent sodium iodide alone, a fact which is of interest when it is recalled that iodine possesses a selective absorption apart from its atomic weight, so that the relative density of its shadow increases with increasing penetration of the roentgen rays.

We have decided, therefore, after consideration of all possible antiseptics in connection with a pyelographic solution, that 1:3000 mercuric iodide in 12 per cent sodium iodide is the most satisfactory. We find that sodium mercuric iodide of this strength has a phenol coefficient of 0.033. In other words it is comparable, on this basis, to 3 to 4 per cent carbolic acid. Used in equal amounts with a colon bacillus infected urine, it destroyed bacterial growth in two and one-half minutes. The solution retained in the mouth for a considerable period produces a salty taste, but no irritation of the buccal mucosa. Introduced into the circulation of a rabbit, it produced no significant change in the condition of the animal so far as heart, blood pressure, and respiration were concerned.

Of course the final test of this solution rests in its clinical application. It is employed routinely in our clinic and thus far we have observed no immediate or subsequent ill effects or discomfort, following its use in either the bladder or renal pelvis, even in the presence of active inflammation. The addition of the antiseptic sacrifices in no degree the value of the medium from the standpoint of the X-ray density.

In conclusion, we wish to recommend the use of 1:3000 mercuric iodide in 12 per cent sodium iodide solution, as an antiseptic pyelographic medium for two important reasons: (1) It reduces to a minimum the risk of introducing infection; (2) it provides some degree of positive benefit, apart from diagnosis, in cases in which infection already exists.

Preparation of the solution: The solution is prepared by dissolving 1 gram of mercuric iodide in 3000 cc. of 12 per cent sodium iodide. The latter is made with chemically pure sodium iodide and distilled water. The final solution does not need to be boiled.

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TEMPORARY SUPPRESSION OF URINE FOLLOWING DOUBLE PYELOGRAPHY[1]

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The following case is reported for the purpose of calling attention to the dangers of doing a pyelography on both kidneys at the same time.

Since pyelography was first introduced into urological practice we have found it a valuable adjunct in kidney diagnosis and have used it as a routine measure in all of our kidney cases in the Long Island College Hospital. We at first used collargol as a solution for getting an opaque shadow of the pelvis of the kidney, but applied it to only one kidney at a time. Later, as reports came in showing the dangers of collargol, we changed our solution and made use of the thorium solution, but a number of months ago replaced that by a solution of bromid of sodium, which is supposed to be absolutely non-irritating and perfectly safe.

Having used bromid of sodium in a great many cases without any signs of irritation or suppression of urine, on one side, a few months ago we began doing pyelography simultaneously on both kidneys with bromid of soda solution, 25 per cent, and had never had any bad results prior to the case which is here reported.

M. L. F., age twenty-nine, married, a strong, vigorous young man, entered Long Island College Hospital January 12, 1922. The history pointed to a calculus in the left kidney or ureter, the patient having had several attacks of renal colic, the last one December 7, 1921. His urine was cloudy, acid, specific gravity 1024, with a large amount of pus and a moderate number of red blood cells. Cystoscopy January 13 showed the bladder to be normal. On the right side a no. 6 catheter passed all the way to the pelvis of the kidney; in the left ureter an obstruction was met about 2 inches from the bladder, but the catheter finally passed by and entered the pelvis of the kidney. The urine which was withdrawn from the right kidney contained no pus or casts, 4 grains of urea to the ounce, a few streptococci, and the phthalein appeared in four minutes. The urine from the left kidney was cloudy, but contained no pus, casts or bacteria. There were 2 grains of urea to the ounce on this side, and the phthalein appeared in four minutes. A radiograph was taken with the catheters in place and showed no shadow in either kidney, but the shadow of a small calculus was clearly visible in the lower ureter, 1½ inches from the bladder. The pelvis of each kidney was then filled with bromid of soda, 25 per cent solution, by the gravity method and pyelograms were made. The patient did

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[1] Read at the meeting of the American Association of Genito-Urinary Surgeons, Washington, D. C., May, 1922.

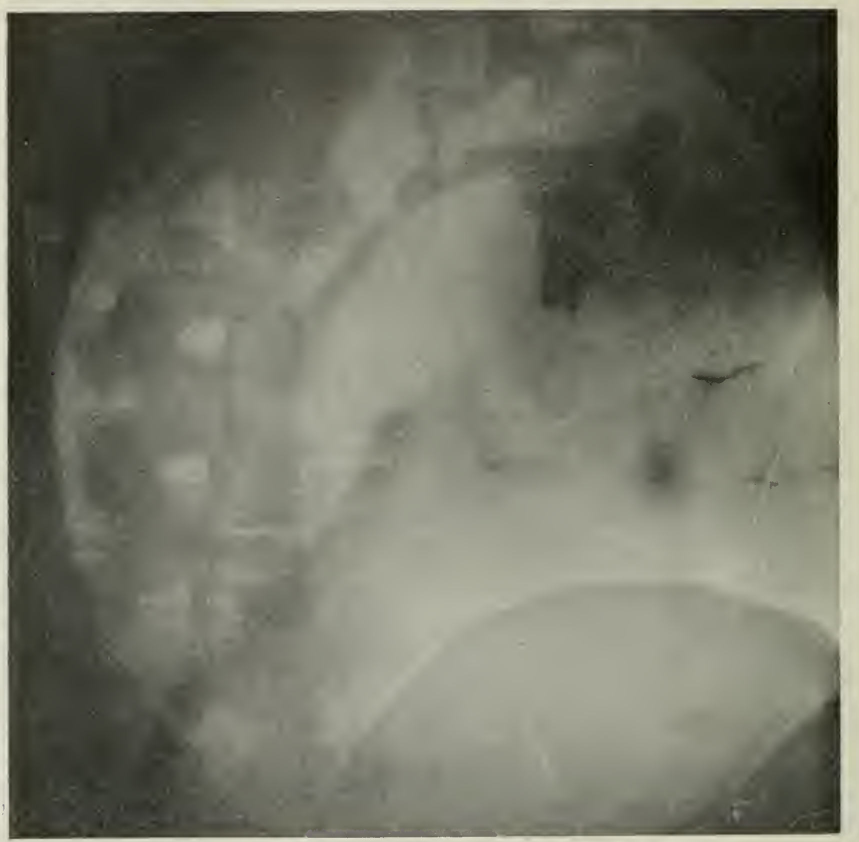

Fig. 1. Pyelogram of Right Kidney after Introduction of 7 cc. Na Br

not complain of pain at the time, but on returning to the ward he complained of severe pain in both kidneys, which lasted throughout the night, and complete suppression of urine followed. For two days following, no urine was secreted, although active treatment was carried out by means of hot packs, forced water by mouth, Harris drip and caffein.

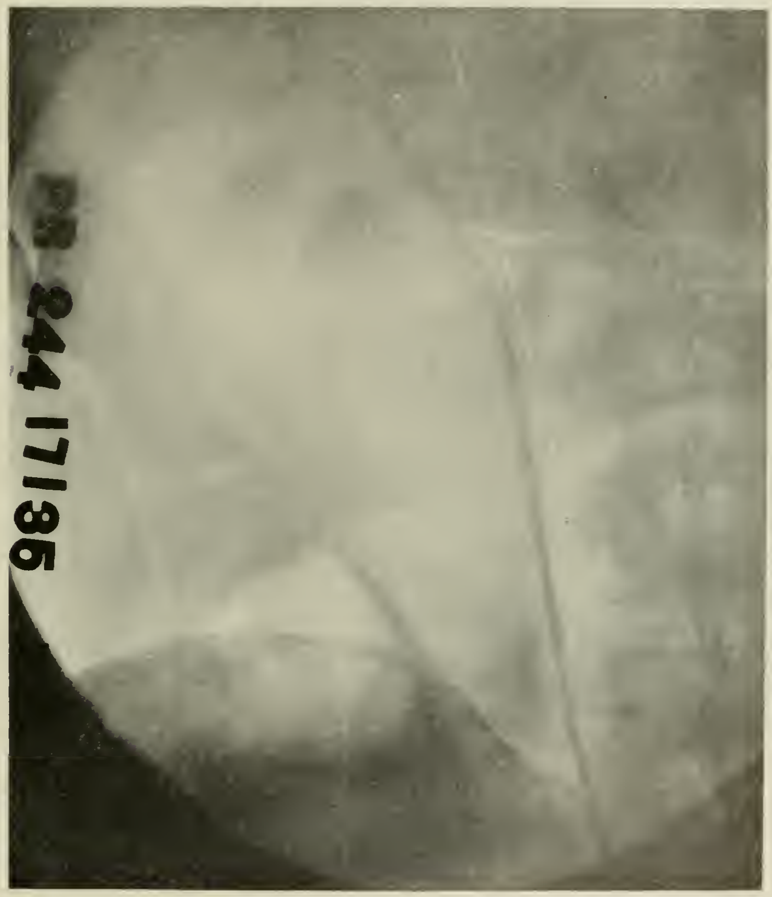

FIG. 2. PYELOGRAM OF LEFT KIDNEY AFTER INTRODUCTION OF 5 CC. NA BR

At this time we began to consider the advisability of cutting down on the kidneys and splitting the capsules to relieve the tension. During this time the patient looked well, felt well otherwise, had no discomfort, and the temperature, pulse and respirations were normal.

Late in the afternoon of January 15 the patient voided 4½ ounces of urine containing pus and blood microscopically.

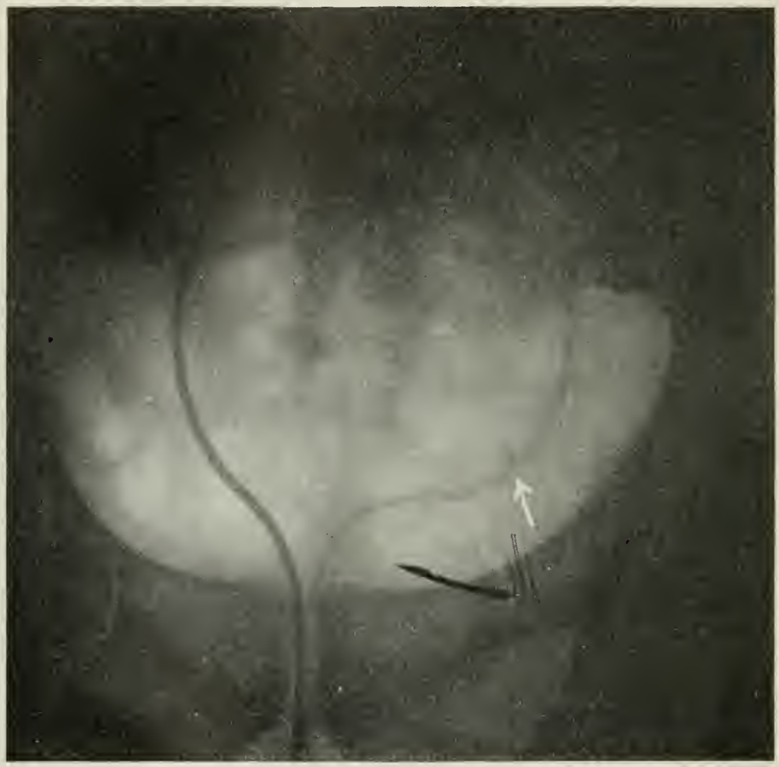

FIG. 3. CALCULUS IN LOWER END OF RIGHT URETER

The blood chemistry, after forty-eight hours of suppression, showed:

	mgm. per 100 cc.
Urea nitrogen	75
Urea	160.5
Uric acid	12.5
Creatinin	11

The following day the urinary secretion had increased to 44 ounces, and on the two succeeding days the urinary output was 90 and 102 ounces, respectively, for the twenty-four hours.

On January 18, the patient was voiding freely, felt well, and the blood chemistry was as follows:

Blood chemistry forty-eight hours after secretion was established:

	mgm. per 100 cc.
Urea nitrogen	16.7
Urea	35.7
Uric acid	3
Creatinin	2

We concluded, from the radiographic shadow of the calculus in the lower ureter, that the attacks of renal colic from which the patient had suffered were due to the passage of a small stone through the ureter to its point of lodgment near the bladder, and on leaving the hospital the radiograph showed the small calculus originally seen, still located at the same point. We shall make an attempt later to remove it by means of the operating cystoscope.

This case is instructive in illustrating the danger of attempting a double pyelography at the same time, for if the secretion of one kidney is impaired, the patient has the other kidney with which to carry on elimination until the temporary anuria has subsided.

TREMENDOUS BILATERAL URETERAL DILATATION IN AN ADULT

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Case reports of ureteral dilatation of extreme degree are not exceedingly rare. Among collected cases of this class, the ureters have occasionally been described without exaggeration as being as large as the small intestine. In most instances the ureteral dilatation has been discovered by post-mortem examination of male infants, and is associated with and, quite apparently secondary to, congenital obstruction of the posterior urethra by a flap or valve. Young, Frontz and Baldwin (1) have recently reported twelve such cases, most of which were diagnosed during life, the diagnosis being suggested by dysuria, pyuria, distended bladder and lowered kidney function in a male infant, and confirmed by urethroscopic findings and cysto-ureterogram. Seven of the 12 cases of congential obstruction of the posterior urethra reported by Young, Frontz and Baldwin were under two years of age. The oldest in which dilated ureters were demonstrated by a cysto-ureterogram was twelve, by autopsy, seventeen. These same authors have collected from the literature a series of 24 additional similar cases, consisting largely of autopsy records. These two series have in common the fact that almost all of the patients were male children under ten years of age. In other words, these patients usually die young.

The case herewith presented is of rather unusual interest in indicating the extreme degree of bilateral ureteral and renal dilatation which may exist in adult life, and yet be not incompatible with a fair degree of health. The patient was an adult of forty-one years.

W. W., male, aged forty-one, was referred by Dr. Rodney Bliss, complaining of weakness, difficult urination, and recurrent attacks of chills and fever.

History. No symptoms whatever until age of twenty, when catheterization was necessary during yellow fever. Patient stated clearly that urinary symptoms (pyuria, frequency and dysuria) did not develop until four years later, and have been present to date. During past few years, symptoms of obstruction of the lower urinary tract have been extreme. There have been several catheterizations, always demonstrating a large residual urine. During past five years, at intervals never longer than several weeks, patient has been subject to recurrent attacks characterized by chills and fever. Although there has resulted a gradual loss in weight and increasing weakness, patient has been able to carry on farm work to date.

Examination. Poorly nourished. Appears anemic. Heart and lungs clear. Abdomen negative. Neither kidney palpable. Nothing of interest in general physical examination.

Rectal. Prostate is slightly larger than the normal average, and shows well marked chronic inflammatory changes. Induration extends upward over base of bladder, and in this region on either side the examining finger encounters a peculiar "boggy" induration. As subsequent examination indicated, this boggy mass to either side was due to the ureters themselves.

Urine. Purulent. Centrifuged stained specimen shows numerous pus cells and a profuse mixed infection. Much mucus. Albumen, plus.

Catheterization. Residual urine, 300 cc. No urethral obstruction encountered by small soft rubber catheter.

Phenolsulphonephthalein test. Output during first hour, 5 per cent; during second hour, 5 per cent, after 6 mgm., intramus.

X-ray. Bladder and kidney regions negative.

Wassermann. Negative.

Cystoscopy. No urethral obstruction. Residual urine, 300 cc. Fluid returned fairly clear only after long-continued irrigation. No stone, tumor or ulceration. Bladder mucosa shows diffuse chronic inflammatory changes, with considerable edema, and mottled hyperemic areas. Left ureteral orifice visible and appears normal excepting for surrounding edema. At right corner of trigone is visible what appears to be the small orifice of a diverticulum, from which clouds of pus may be seen to issue, rapidly clouding the irrigating fluid. No intravesical prostatic hypertrophy.

Cysto-ureterogram. Sodium iodide solution was used, 250 cc. of 15 per cent, with the patient in the prone position. Figure 1 shows tremendous bilateral ureteral dilatation, with regurgitation of fluid to the renal pelves, each of which shows a well marked hydronephrosis. In figure 2, the bladder has been drained and filled with air, showing the fluid retained in the ureters, and indicating that the caliber of the ureteral orifices is much less than that of the ureters. This was con-

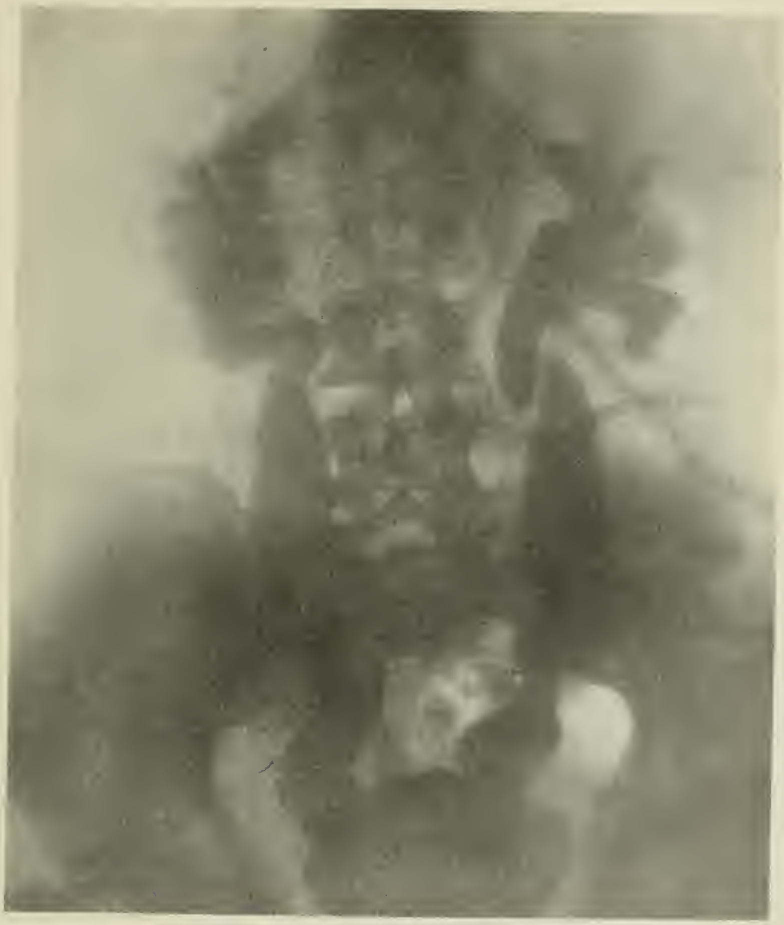

FIG. 1. TREMENDOUS BILATERAL PYOURETER AND PYONEPHROSIS IN AN ADULT OF FORTY-ONE, IN A FAIR DEGREE OF HEALTH

firmed by cystoscopic and operative findings. Figure 3 shows better detail of the region of the vesical orifice, and demonstrates that there is no dilatation of the proximal portion of the posterior urethra, and hence no congenital flap or valve in this region to account for the residual urine.

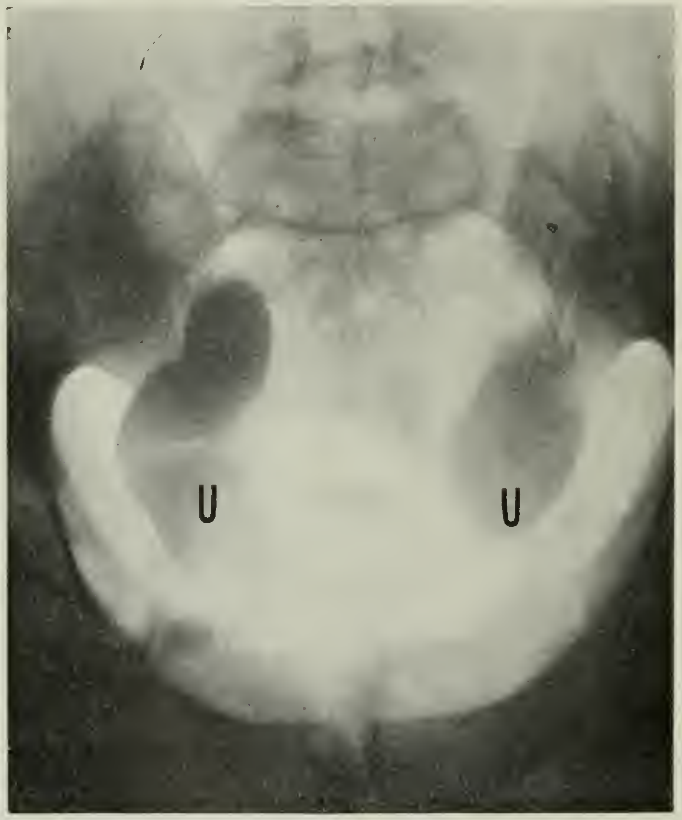

Fig. 2. Showing Fluid Retained in the Uterus (*U*) after the Bladder Has Been Drained and then Distended with Air

The ureteral orifices do not share in the general ureteral dilatation

Operation. Suprapubic cystoscopy, excision posterior median bar, dilatation ureteral orifices. The chief feature of interest within the bladder lay in the densely sclerotic contracted vesical orifice, which was too small to permit the introduction of the tip of the little finger without forceful dilatation. A "punch" operation was done with the Young instrument, excising a deep bit of fibrous tissue, and permitting wide relaxation of the orifice. This opened into a small abscess cavity, permitting the escape of about half a drachm of thick creamy pus.

In spite of the wide ureteral dilatation demonstrated by the cystogram, it was with considerable difficulty that the ureteral orifices were located in the opened collapsed bladder. With the idea that the relatively small caliber of the orifices might be a factor in interfering with ureteral drainage, each was widely dilated.

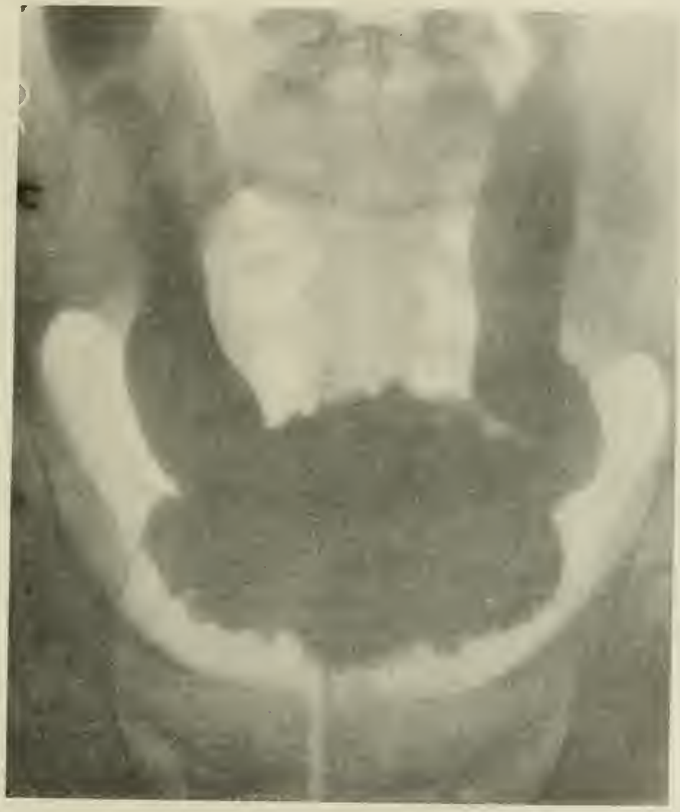

FIG. 3. DETAIL OF BLADDER DEMONSTRATING THAT THERE IS NO DILATATION OF THE PROXIMAL PORTION OF THE PROSTATIC URETHRA, AND HENCE NO CONGENITAL VALVE OR FLAP IN THIS REGION

This opinion was confirmed by operation

Convalescence. The second post-operative day was complicated by hemorrhage from the prostatic orifice. With this exception convalescence was uneventful, the suprapubic fistula closing on the twentieth day. The patient gained in weight, his general condition improved and the amount of residual urine decreased to less than 50 cc. By the end of the fifth post-operative week, the phthalein output had increased to 15 per cent and 10 per cent, during the first and second hours. His condition was entirely satisfactory when he passed from observation.

Subsequent history. Two weeks after patient had left the city (two months from the date of operation) word was received that he had suddenly died after an acute illness lasting but three or four days. No autopsy was made. Efforts to obtain through correspondence reliable data, such as might have thrown light upon the cause of death were without avail.

COMMENT

The etiology of the ureteral dilatation in this case may be no more satisfactorily explained than the cause of death. It is highly improbable that such an extreme degree of dilatation could have had an origin any other than congenital. Yet the patient positively stated that before the age of twenty-four he had no symptoms whatever of urinary obstruction. Furthermore, the lack of dilatation of the proximal portion of the prostatic urethra (indicated in figure 3, and confirmed by operation) rules out as an etiological factor the congenital flap or valve described as occurring in this region. From the data available, the only logical conclusion is that the ureteral dilatation was congenital in origin, and developed without obstruction of the lower urinary tract sufficient to produce symptoms until early adult life when urinary infection followed catheterization. It will be recalled that this latter procedure was necessary on account of acute urinary retention during yellow fever. The dense fibrous contracture of the vesical orifice, the division of which so effectually relieved the residual urine and the symptoms, was probably secondary to chronic infection.

Although the exact etiology of the ureteral dilatation and the immediate cause of death are both obscure, the case is of unusual interest because of the tremendous size of the ureters, because symptoms did not develop until the age of twenty-four, and because the patient lived to forty-one in a fair degree of health.

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A CASE OF HEMATURIA FROM LEAD POISONING

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A search of the literature reveals no case of hematuria similar to the one herein presented from which one would conclude that this is a very rare condition. The manner in which the patient acquired his toxemia is quite unusual indeed. The method of treatment is unique and as far as we know has never before been applied to the treatment of lead poisoning.

W. D. a white male, age forty-seven; Dispensary no. 28,206, presented himself at the urological clinic July 28, 1922, for the relief of a chronic urethral discharge. This patient had contracted an acute gonorrheal infection eight months previous to the time he first came to the clinic. At that time he was complaining of a backache and a nocturia of seven to eight times. He has a wife in the old country and a grown son in this country. He was treated in the routine manner until September 25 when he was given a prescription containing zinc sulphate and lead acetate to be used morning and night as a urethral injection. The four oz. mixture contained of zinc sulphate gr. viii, of lead acetate gr. x.

The patient professed to understand the instructions perfectly and repeated in English his understanding of the matter which was essentially correct. He was next seen on October 9, at which time he had a profuse hematuria. On cystoscopy blood was seen coming from both ureters. On October 11, he had developed pain in the epigastrium and a malaise with a still more severe hematuria. Upon checking up on the case it was found that the patient had consumed two 4-ounce bottles of the above mixture, taking it internally three times a day. He had a pallor and a lead line on his gums. The obvious conclusion was that this man was suffering from a lead poisoning from having taken by mistake a medicine containing lead acetate and intended for application in the urethra. He was sent to the hospital for treatment and observation. The blood examination showed the characteristic stippling of the red cells commonly accompanying the toxemia produced by lead. He had casts and albumin in this urine in addition to blood. His red blood count was 4,288,000; 75 per cent hemoglobin; 7000 white blood cells. He was immediately given daily injections of 0.6 gram of purified hyposulphite of soda, intravenously. On the second day the urinary hemorrhage ceased and there was no return of it. The patient was kept on hyposulphite injections as above for two weeks. He made a good recovery and is free from symptoms of lead poisoning and has returned to his work.

COMMENT

In 1920 Ravaut (1) of Paris, suggested the use of hyposulphite of soda in dermatitis due to arsphenamine. He used it with excellent results on other dermatoses and in connection with arsenic dermatitis said that it probably formed an insoluble sulphite of the metal.

McBride and Dennie (2) in this country have experimented quite extensively with hyposulphite of soda and have treated a large number of arsphenamine dermatitis or exfoliative dermatitis cases as well as other metallic poisonings with results that are uniformly excellent.

Ravaut (1) advocated a 20 per cent solution of the sodium hyposulphite and a daily intravenous administration of from 4 to 15 grains.

At this time, three months after discontinuing treatment the patient is perfectly well and no longer shows stippling of the red cells. This method of treatment of metallic poisoning certainly should receive the careful consideration of the entire profession.

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SOME OBSERVATIONS ON THE LENGTH OF SURVIVAL AND FUNCTION OF HOMOGENOUS KIDNEY TRANSPLANTS

PRELIMINARY REPORT

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The possibility of replacing diseased kidneys by the transplantation of normal ones has long been a fascinating problem in experimental surgery. Many experimental studies have been made on this problem, most of them in an effort to eliminate some of the surgical and mechanical difficulties of the operation. The improved technic of blood vessel suturing that has resulted has put the operation of transplanting such organs as the kidney, with a reëstablished circulation, on a firm basis for experimental purposes. It is our purpose in this study to compare the behavior of autogenous and homogenous kidney transplants as regards length of survival after operation, and at the same time to observe the function of homogenous transplants.

REVIEW OF THE LITERATURE

The year 1902 (1, 7) marked the beginning of the literature on experimental transplantation of the kidney. These efforts, however, added little to our knowledge, as in most instances the blood-vessel surgery was unsatisfactory. Carrel and Guthrie (2) in 1905 developed a method of blood-vessel suturing that has assured a high percentage of mechanically successful operations. These two authors (3) have since then at various times reported experiments of this type.

In 1908 Carrel (4) reported a series of homogenous kidney transplants in which both kidneys were removed from the recipient by a mass dissection, and replaced by a similar mass from the donor. Seven experiments are reported in detail. The shortest length of life after operation was six days, and the longest thirty-nine, the average being sixteen days. After operation, the transplanted kidneys seemingly had good function up to the time of death. Urinalysis was made, but blood urea was not followed. The author made no attempt to explain, other than by surgical accidents, the occurrence of edema, nephritis and calcification which were frequent complications in these experiments.

The next work upon the subject of kidney transplantation was that of Dederer in the laboratory of the Mayo Clinic in 1916 and 1917. Dederer used the cervical region for his transplants. He made one homogenous transplant, following which the animal survived twenty-six days after both normal kidneys had been removed. Studies were made concerning the time at which phenolsulphonephthalein appeared, and it was found to be normal. The recipient and donor in this experiment were sisters. The recipient died of distemper on the twenty-sixth day after operation. The fact that this successful experiment was made upon members of the same litter of puppies seems very suggestive that there are biologic phenomena which may be instrumental in the failures that have so frequently been attributed to mechanical difficulties.

Our experiments are divided into two groups for comparison. One of these groups consists of autotransplants, and the other, of homotransplants. The operative technic for both groups was exactly the same, and will be briefly described.

OPERATIVE TECHNIC

All experiments were made on dogs, under ether anesthesia, and with sterile operative technic. Transplants were always placed in the neck, where the renal vein was anastomosed to the external jugular vein, and the renal artery to the common carotid. The ureter was brought to the outside through a stab wound. The operation, for convenience in description, is divided into two stages, that upon the recipient, and that upon the donor.

The neck vessels of the recipient were prepared for blood-vessel anastomosis before the kidney has been removed from the donor. A straight incision was made over the external jugular vein, extending from just below the cricoid cartilage to the level of the supra-clavicular fossa; this area in the dog corresponds to the clavicular area in man. The external jugular was freed for a distance of approximately 12 cm. After this was satisfactorily freed, a clamp was placed on the vein at the upper angle of the wound. A second clamp was placed on the vein about 4 cm. above the lower angle of the wound. A small, covered, bull-dog clamp was placed on the vein at its lowest angle, to control the vein after the segment had been removed (Fig. 1). The vein was sectioned on the proximal side of both crushing clamps and the distal end of the vein ligated. After removing the segment of vein, the external carotid was dissected out and prepared

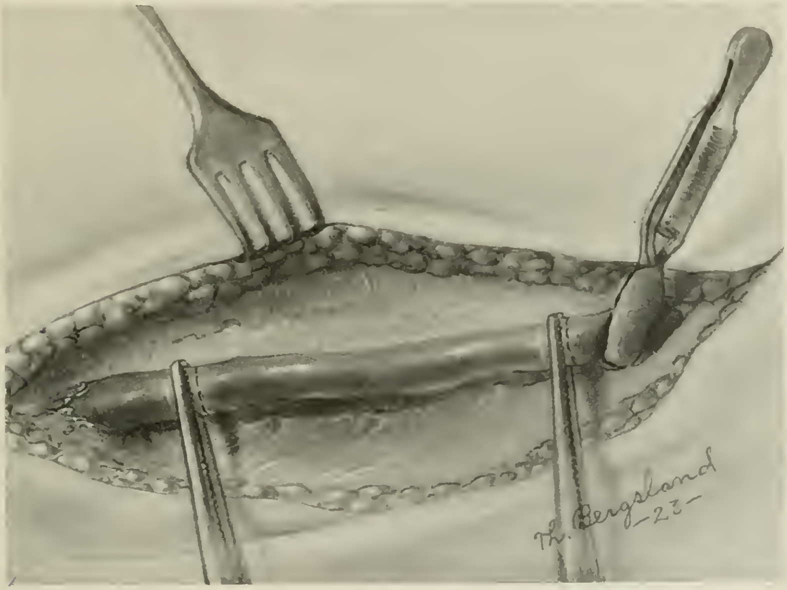


FIG. 1. CLAMPS IN PLACE FOR REMOVING SEGMENT OF VESSEL

in the same manner as the vein. The ends of the carotid and external jugular vein were then prepared for anastomosis. This was done by carefully removing all adventitia for a distance of at least 0.5 cm. from the ends of the vessels. After this had been done, and a pocket prepared for the kidney by separating muscles in the region of the carotid sheath, the ends of the vessels were given a generous application of liquid petrolatum and covered with a warm salt pack until the kidney had been prepared.

A middle line incision was made in the donor, and the left kidney removed with as little trauma as possible. Occasionally we found that the renal artery entered the aorta as two distinct arteries. This made it impossible to use that kidney for transplantation, as the renal arteries, when single, are only about 1 to 2 mm. in diameter, but when double even this diameter is decreased. The renal artery was always clamped first to prevent undue engorgement of the kidney. All vessels that were to be subsequently sutured were divided with a knife. The renal vessels divided, the ureter was rapidly dissected out for a distance of from 10 to 15 cm., clamped and ligated. The kidney was then carefully wrapped in a warm salt pack and moved to the site of the future anastomosis. The time that the circulation was cut off from the kidney was reckoned as the time which elapsed between the clamping of the renal vessels and the reëstablishment of the circulation through the carotid artery and jugular vein. The abdominal incision in the donor was not closed until after the transplantation had been completed. Before beginning the anastomoses, however, it was necessary to prepare the renal vessels for suturing. This being done, the artery was anastomosed first.

The technic that we employ for blood-vessel suturing is essentially that described by Carrel and Guthrie. It consists of dividing the vessel as nearly as possible into an equilateral triangle by three so-called stay sutures. These sutures are loosely placed until all are in position, then by gradual traction on all the sutures, the two ends of the vessels are approximated, and all three stays are tied. One of the stay needles is used for suturing. After the guides have been tied, the assistant holds them in such a manner that a triangle is formed (Fig. 2). This obviates the danger of suturing the opposite wall of the vessel. The sutures are of the continuous Lembert type, and penetrate both the media and intima. Upon completing the suture of the first side of the triangle, the vessel is rotated so that one always has a straight edge to suture, and this is always on top. The vein is sutured in the same manner as is the artery.

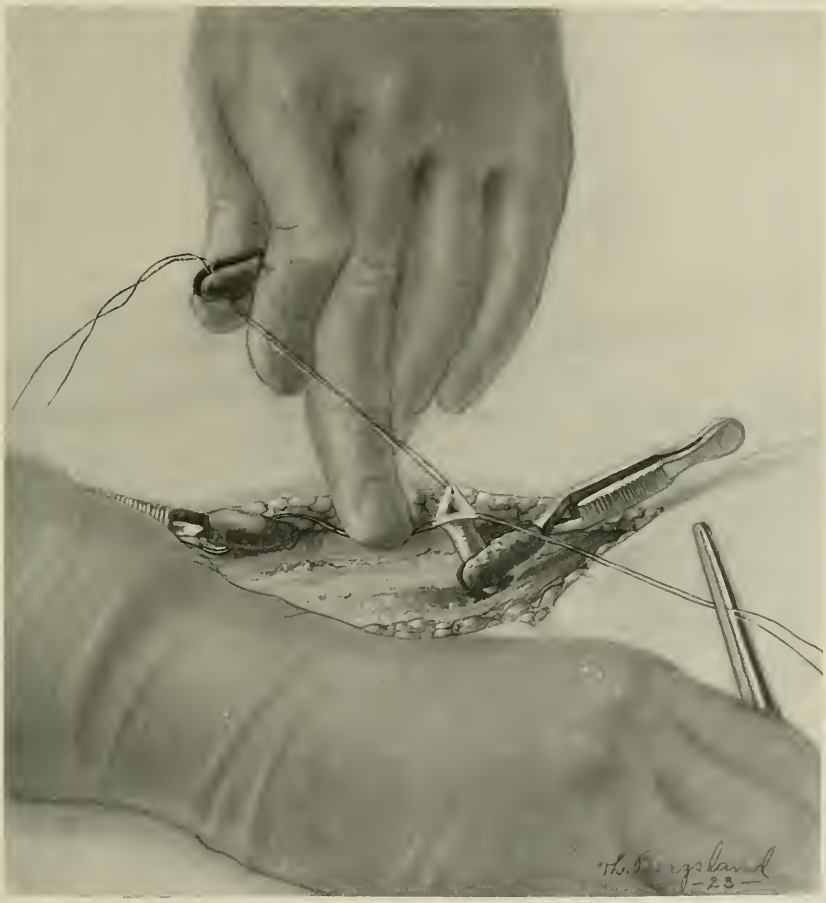


FIG. 2. TRIANGLE FORMED BY THE GUIDE SUTURES

After completing the suture of the artery and vein, we were ready to release the blood. Before doing this, however, the

✓ sutures were cut, and the vessels packed off. In releasing the blood, the clamp was taken off the venous side first. Occasionally, hemorrhage was encountered after the clamps were removed, but this was easily controlled either by hot pack, or one or two additional sutures. Within thirty seconds the kidney assumed a normal color, and for about five minutes was very hard and tense. The tenseness rapidly passed away, and the kidney had a normal "feel". A catheter was inserted into the ureter up to the pelvis of the kidney, and then withdrawn a short distance and held in position with a ligature around the distal end of the ureter. This ligature had a two-fold function in that it maintained the catheter and controlled bleeding from the ureteral vessels.

The kidney was next dropped into its muscle bed, and the vessels inspected to see that no kinking or obstruction was present. The ureter was brought out to the surface through a stab wound, and the neck incision closed. The wound was closed without drainage with interrupted catgut sutures, and the skin incision by a continuous linen suture. Small amounts of urine were often being discharged from the ureter by the time the skin incision was closed; a small sterile gauze sponge was placed over the end of the ureter to protect it as the animal recovered from the anesthetic. This was removed in a few hours, and the ureter left unprotected.

OBSERVATIONS

Our observations in this series of experiments may be divided for convenience into those on autotransplants, and those on homotransplants. By autotransplantation we mean transplanting the organ from its natural position to a new location in the same animal, while by homotransplantation, we mean taking a kidney from one animal and transplanting it to another member of the same species.

Observations on autogenous kidney transplants

The autogenous transplants were made as a control for the experiments in which homogenous transplants were used. In this manner it seemed to us that a fairly accurate index could be obtained on the behavior of the homogenous transplants.

We have found that, if we transplant one kidney of an animal to the neck, and in a few days remove the other kidney, the transplanted kidney will maintain life for months. The rate of secretion from this kidney is increased. The urine that is secreted is alkaline. In most of these experiments urinalysis yields fairly normal results. The phenolsulphonephthalein, although diminished, is not markedly so, and the blood urea varies between 30 and 40 mg. for each 100 c.c. After several months the urine picture changes; the albumin increases, pus cells increase, and the blood urea increases to between 60 and 100. Externally, the kidney is observed to enlarge, and if pressure be made on it, a relatively large amount of urine is expressed. In other words the kidney plainly suffers from hydronephrosis and infection. The hydronephrosis and infection continue until the death of the animal with typical uremic symptoms. The obstruction to free drainage can readily be accounted for by the contraction of the neck muscles obstructing the flow of urine as the animal moves its head from side to side, and by the cicatricial contraction of the skin around the ureter with perhaps actual atresia of the ureter. Peristalsis of the ureter becomes very marked near the end of the experiment. In fact, the urine is sometimes ejected several feet from the animal at frequent intervals. The most significant observation on this type of experiment is the fact that despite the mechanical insults, the destruction of the extrinsic nerve supply of the kidney, and the unsatisfactory location of the organ, it will maintain life for weeks, with apparently nearly normal function.

Observations on homogenous kidney transplants

The homogenous transplants present an entirely different result. Following the homogenous transplantation of a kidney, the results for a time are similar to those of the autotransplants. That is to say, a copious flow of urine begins within a few hours after transplantation.

Chemical analysis of the urine from the transplanted kidney and from the two normal kidneys was made, and the data are given in Table 1. It will be noted that the total amount of urea excreted before and after operation is changed, and the ratio of urea, urea nitrogen, and creatinin excreted by the transplant, and by both normal kidneys is worthy of study. This increased output might be explained on the basis of a larger blood supply in the transplant than in the normals, and the destruction of the extrinsic nerve supply of the kidney may also be a factor. These possibilities are mentioned at this time as worthy of consideration, but a discussion of their relationship and etiology will be given in a more detailed report at a later date.

TABLE 1

Chemical analysis of urine from homogenous transplant

DOG F675		MILLIGRAMS FOR EACH 100 C.C.		
		Urea	Urea nitrogen	Creatinin
Urine collected from all three kidneys for one hundred sixty-five minutes, forty-eight hours after operation	Transplanted kidney..	1584	732.5	1.3
	Normal kidneys......	1860	868.0	0.7
Total excretion of all three kidneys..................		3444	1600.5	2.0
Percentage of total excreted by transplant...........		46	45.7	65.
Percentage of total excreted by both normal kidneys..		54	54.3	35.

TABLE 2

Chemical analysis of the blood from homogenous transplants

DOG F675		MILLIGRAMS FOR EACH 100 C.C.			REMARKS
Date	Time	Urea	Urea nitrogen	Creatinin	
May 1, 1923	2:30 p.m.	26	12.1	1.7	
May 2, 1923	3:30 p.m.	20	9.3	1.7	Secretion good six hours after operation
May 3, 1923	11:45 a.m.	18	8.4	1.6	Secretion good
May 4, 1923	9:15 a.m.	12	5.6	1.5	Secretion good
May 5, 1923	10:00 a.m.	18	7.5	1.7	Kidney almost stopped secreting

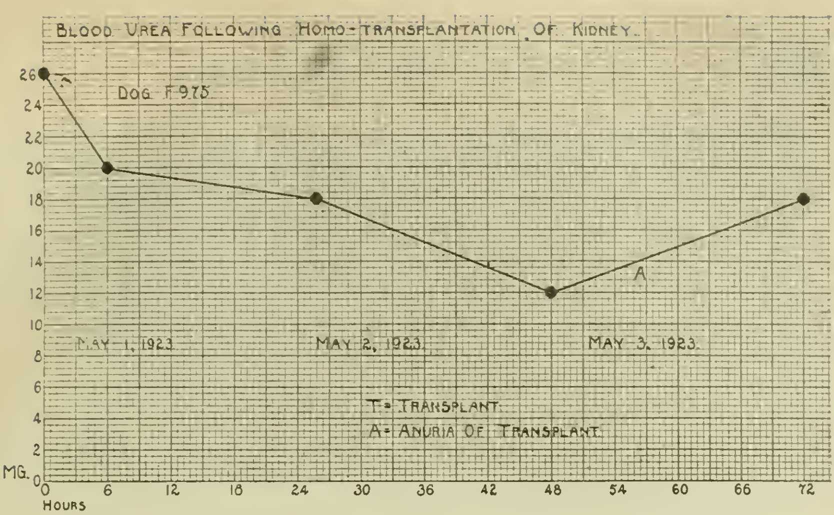

BLOOD UREA FOLLOWING HOMO-TRANSPLANTATION OF KIDNEY.
DOG F 975
26
24
22
20
18
16
14
12
10
8
6
4
2
MG. 0
A
MAY 1, 1923
MAY 2, 1923
MAY 3, 1923
T = TRANSPLANT
A = ANURIA OF TRANSPLANT
0
6
12
18
24
30
36
42
48
54
60
66
72
HOURS

FIG. 3

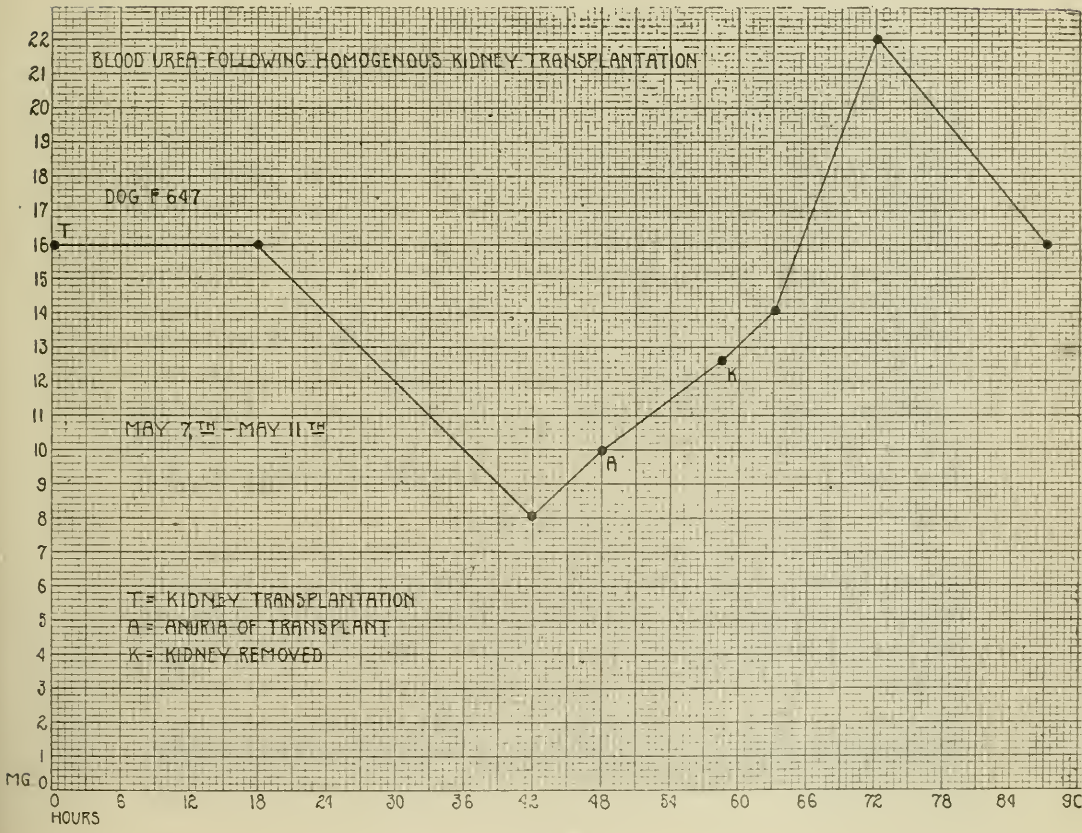
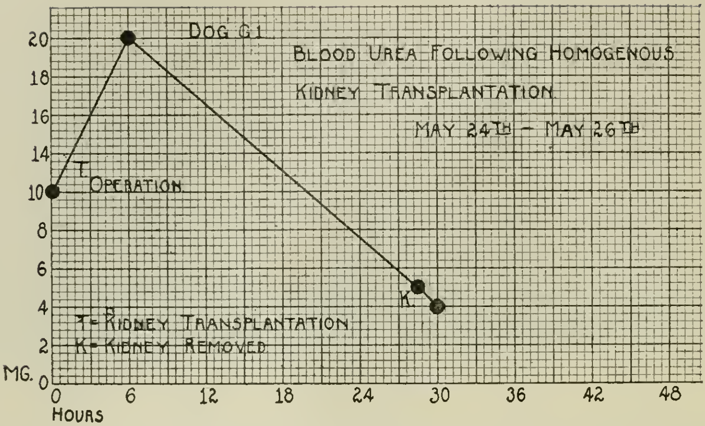

BLOOD UREA FOLLOWING HOMOGENOUS KIDNEY TRANSPLANTATION
22
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
MG 0
DOG F 647
T
K
A
MAY 7TH – MAY 11TH
T = KIDNEY TRANSPLANTATION
A = ANURIA OF TRANSPLANT
K = KIDNEY REMOVED
0
6
12
18
24
30
36
42
48
54
60
66
72
78
84
90
HOURS

FIG. 4



Figs. 3, 4 and 5. Charts showing the blood urea following transplantation of the kidney

During the time that the transplanted homogenous kidney had been functioning, as well as the animal's normal kidneys, we have made determinations of the blood urea, urea nitrogen and creatinin (Table 2). Figures 3, 4, and 5 show the behavior of the blood urea following transplantation. This seems to indicate that with three kidneys functioning, a rather marked reduction of blood urea, urea nitrogen and creatinin occurs. That the transplanted kidney is largely responsible for this reduction seems fairly certain, as the beginning failure of this kidney is shown by an increase in the urinary excretory products in the blood. In further studies it will be interesting to determine whether the blood can be rendered free, or practically free, of urea, urea nitrogen and creatinin by the transplantation of two or more kidneys in addition to the animal's normal kidneys.

The results of urinalysis of the excretion from the transplanted kidney in many respects resemble that of the autogenous experiments. The reaction of the urine from homogenous experiments may be either neutral, alkalin or acid. The phenolsulphonephthalein output is about the same as observed in the autotransplants. In other constituents of the urine, very little difference between the urine from autogenous and homogenous transplants can be noted, but this similarity of function is of relatively short duration. We have found that the average duration of function following a transplant of this type is four days. Some of the transplanted kidneys will function only twenty-four hours, while others will have excellent function for a week or more. The beginning failure of function by these transplants is characterized by a slightly diminished volume of secretion, with increased specific gravity, and but slight change in output, an increase in pus cells, and also appearance of renal epithelium, casts and the formation of a pellicle in the urine. These changes may continue gradually until secretion stops. Unless a number of these experiments are observed, the erroneous idea that there is interference with drainage of the ureter is likely to be obtained. This idea is also strengthened by the fact that coincident with the diminution of secretion there is an increase in the size of the tumor of the neck. If the kidney be removed at the time of suppression, it will be found that a large amount of edema is present around the kidney, and often free fluid which clots; the kidney may also be enlarged. The capsule generally appears fairly normal.

The blood supply is readily determined by noting the pulsation of the kidney, and its enlargement if the vein be compressed. The kidney on section, is very edematous, and the pelvis may be slightly dilated, but the fluid found seldom exceeds 10 c.c. From this we have been led to believe that a homogenous kidney transplant functions for a time as does an autogenous kidney transplant, but after a few days this function fails, and within a relatively short time ceases entirely. This failure we believe cannot be attributed entirely to faulty drainage of the ureter, thrombosis of the vessels, or infection.

DISCUSSION

This series of experiments is interesting not entirely because of the data here presented, but also because of the large number of problems that seem to have been opened for investigation. Yet we believe that, although certain of our observations are incomplete and unexplained, they are definite.

Special attention should be called to the marked difference in the behavior of autogenous and homogenous transplants. In the beginning, both types seem to function alike, but this similarity is of short duration. The autogenous transplant will function and maintain life for months, whereas the homogenous transplant under exactly the same experimental conditions will function for an average period of only four days. In the past this failure has largely been attributed to external conditions, such as thrombosis of the blood supply, obstruction to the ureter, and infection. But the fact that the autogenous transplant survives in spite of these factors seems largely to disprove the so-called mechanical theory of failure. From our observations we are led to believe that mechanical defects in the operation, although important in all these experiments, cannot be considered as the primary cause of failure in the homogenous kidney transplant. It seems to us that, underlying these failures is some fundamental biologic principle which we have not yet been able to identify. It is unfortunate that the lower animals, such as the dog, do not possess a blood grouping like that of man. In the future it may be possible to work out a satisfactory way of determining the reaction of the recipient's blood serum or tissues to those of the donor, and the reverse; perhaps in this way we can obtain more light on this as yet relatively dark side of biology.

The function of these homogenous kidney transplants is of particular interest despite the fact that they survive only a few days after operation. These kidneys have a very definite urinary excretion as evidenced by (*a*) the phenolsulphonephthalein output, (*b*) the comparatively normal amount of urea, urea nitrogen and creatinin, (*c*) the reaction in urea, urea nitrogen and creatinin of the blood during the time that the transplanted kidney is functioning, and the return to a normal amount immediately after the transplanted or third kidney is removed. The fact that the amount of urea, urea nitrogen and creatinin eliminated by the transplanted kidney is at times greater than the amount excreted by either of the normal kidneys is of interest, and may possibly be explained by the greater blood supply of the transplanted kidney.

As yet we do not feel justified in attempting to explain definitely any of the observations that we have made in this preliminary report.

SUMMARY

1. Autogenous kidney transplants will maintain life for weeks in a practically normal manner after the removal of the remaining normal kidney.
2. The failure of the autogenous transplant seems to be due to atresia of the ureter, hydronephrosis and infection.
3. The homogenous kidney transplant functions as does the autogenous one for a limited time, but this function continues for only a few days.
4. The average length of function for the homogenous transplant has been four days, and the maximum, ten days.
5. During the time that all three kidneys are functioning, two-hour test periods of the function show that the amount of urea, urea nitrogen and creatinin eliminated by the transplanted kidney is only slightly less than the combined output of both normal kidneys.
6. The total amount eliminated by all three kidneys is more than was eliminated by the normal kidneys before operation.
7. During the time that all three kidneys are functioning there is a sharp reduction of the nitrogenous elements of blood urea, urea nitrogen and creatinin.
8. We do not believe that the failure of the homogenous experiments can be attributed to mechanical factors.

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LEUKOPLAKIA OF THE BLADDER[1]

REPORT OF A CASE

JULIUS J. VALENTINE

Received for publication November 21, 1922

Leukoplakia of the urinary tract has been studied and reported mostly by French and German workers. In reviewing the literature available during the past twenty years, one is surprised to find very little written in English on the subject. Case reports by Zipser (1 case), A. T. Cabot (1 case), Beer (2 cases) and latterly Kretschmer (1 case) were the only ones found in the American literature.

The rarity of the condition, its unknown etiology and its very uncertain cure are the reasons for presenting this case in hope of stimulating further study of the subject.

Male. Age thirty-five. Occupation, artist.

First seen July, 1919.

Family history. Negative.

Personal history. He vaguely recalls that at about the age of twelve he consulted a physician because of backache and cloudy urine. He is uncertain as to whether he had hematuria, but states that at this time his urine had a very heavy, reddish, cloudy sediment. Recalls no further details.

Nine years ago he thinks his urine was clear and he passed life insurance examination.

He has observed for many years that whilst his urinary stream was free he felt that he did not entirely empty his bladder when he voided. This, however, did not disturb him and he consequently sought no advice.

He was admitted to military service and subjected to many hardships, exposure to cold and wet while driving an ambulance in the French Corps during the late War.

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[1] Presented before Section of Genito-Urinary Surgery, New York Academy of Medicine, October 18, 1922.

Venereal history. Gonorrhea in 1910 and 1914, complicated by severe, acute prostatitis. Had many recurrences and states that he was never entirely well. Contracted syphilis in 1919, for which condition he presented himself. At this time he had a maculo-papular eruption on his forehead, entire trunk and arms. Mucous patches in mouth and throat. His urine prior to beginning antiluetic treatment showed a distinct trace of albumin, a moderate number of pus corpuscles with a moderate number of epithelia from the pelvis of the kidney and the kidney proper. Wassermann was 4 plus.

Diagnosis. Active syphilis and mild pyelonephritis.

He received intensive treatment for two and one-half years and is now in good general health with two negative Wassermann tests six months apart.

A few months after he was under treatment he presented himself with a urethral discharge which appeared three days following two seminal emissions occurring in one night. No coitus.

Urethral and prostatic smears showed abundant pus corpuscles together with intra-and extracellular gonococci as well as staphylococci. All tubes of urine were turbid due to pus containing the usual shreds, filaments and flakes. Prostate small, symmetrical, soft with distinct areas of induration disseminated. Left vesicle was palpable and slightly tender.

Diagnosis. Acute recrudesence of chronic gonorrhea, plus streptococcus infection. Pyelonephritis.

He was treated for several months and all active symptoms disappeared leaving, however, a persistent, turbid urine which was strikingly free from the shreds usually seen, but in their stead were observed a large number of irregularly sized, flat, shining, thin flakes or placquelets most of which sank rapidly to the bottom of the glass.

No hematuria or renal colic has ever existed. No frequent, urgent or painful urinations. In fact there has been a rather sluggish or lazy disire to empty the bladder, many hours intervening between voidings. Neurological examination was negative. Spinal fluid: negative. Attempts to catheterize his bladder with a soft catheter were made, but failed on account of an obstruction in the deep urethra. Later it was found that only a Mercier 45° angle beak directed toward the right, upper segment of his tract (11 o'clock) would enter his bladder. Counter pressure in the rectum would facilitate this proceedure. His posterior urethra measures over 3½ inches in length. *Residual urine* varied from 100 to 200 cc. Bladder capacity 300 cc.

Cystoscopy. Cystoscope passed with the same difficulty, just mentioned, showed a normal bladder vault and lateral walls. A moderate number of trabeculations. A rather intensely reddened trigone in the center of which was seen a snow white patch of flocculent membrane, irregular in outline with sharply defined borders about the size of a 25 cent piece. Ureteral orifices somewhat reddened and puffed. No diverticulum seen.

Cysto-urethroscopy showed an abnormal elevation of the sphincter margin posteriorly, the instrument giving a distinct "snap" or "click" on withdrawal.

Added diagonsis. Leukoplakia. Abnormal posterior urethra and sphincter, simulating contracture of vesical neck.

No ureteral catheterization was performed at this time for fear of aggravating his renal condition.

Irrigations of his bladder were carried out at varying intervals with different solutions including silver salts, oxycyanide of mercury, acriflavine and mercurochrome. His urine cleared somewhat from time to time, but the characteristic shiny placquelets remained in abundance.

He was given a rest for a few months during which time he took hexamethylamine and acid sodium phosphate.

When next seen he felt very well and had no urinary disturbance despite his still turbid urine. Urinalysis: Acid. Specific gravity, 1.022. Albumin, moderate trace. Urea, 1.7 per cent. No sugar, acetone or diacetic acid. Indican increased. No casts, crystals or blood. Pus, $\frac{1}{8}$ inch in centrifuge tube. Epithelia from upper layers of bladder, abundant; from upper tract, few. Bacteria, heavy growth of long chain streptococci, few Gram negative bacilli. Culture: long chain streptococci, non-hemolozing, which gave B. coli reactions on sugar. No tubercle bacilli.

Radiography of the urinary tract was negative. Cystogram shows nothing abnormal.

Bilateral ureteral catheterization, November, 1921.

	RIGHT	LEFT
Appearance	Slightly cloudy	Clear
Albumin	Trace	Trace
Pus	Moderate numbers	Moderate numbers
Blood	Present	Present
Epithelia	Kidney, pelvis and ureter	Kidney, pelvis and ureter
Bacteria	Gram negative bacilli	Gram negative bacilli
Phthalein:		
Appearance time	$4\frac{3}{4}$ minutes	7 minutes
Percentage	12.5 in 10 minutes	15 in 10 minutes
Amount collected	10 cc.	10 cc.

No pyelogram was made for the reasons previously stated.

For purely experimental purposes an autogenous vaccine was made from his bladder urine culture and progressively graduated doses given for a period of time without apparent beneficial results.

Cystoscopy. Three months ago (July, 1922). Area of leukoplakia has spread somewhat. Central portion of lesion in trigone is larger. Laterally, its offshoots have spread to around the ureteral orifices and forward as well as downward to the margin of the sphincter, giving it the appearance of a butterfly or bat with extended wings. Ureteral orifices remain the same as before and distinctly free from any involvement of the lesion. There is no invasion of the process into the urethra.

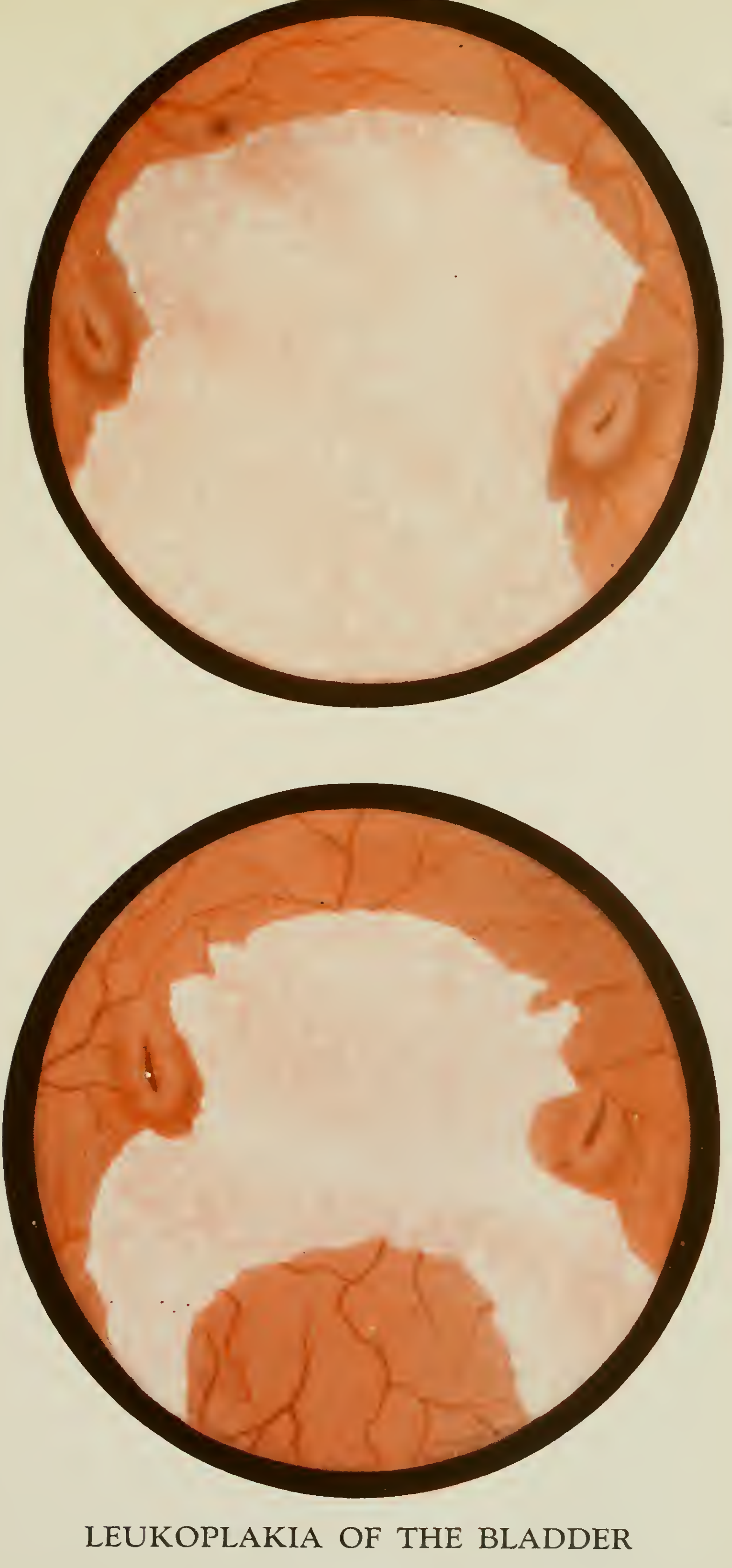
A specimen of the patch with its underlying mucosa was snipped off with the cystoscopic rongeur and the pathological report showed a deep layer of desquamated, squamous, epithelial cells lightly adhering to the mucosa.

Ureteral catheterization was again performed as a check up at this time with the following result:

·	RIGHT	LEFT
Appearance	Clear	Hazy
Albumin	Faint trace	Trace
Pus	Very scanty	In moderate numbers
Blood	Few	Few
Crystals	Calcium oxalate	Calcium oxalate
Epithelial	Kidney, pelvis and ureter	Kidney, pelvis and ureter
Phthalein:		
Appearance time	9 minutes	7½ minutes
Percentage	15 in 10 minutes	12.5 minutes
Amount collected	10 cc.	10 cc.

Note that in this test the left kidney appears worse off than the right, while in the first examination the right appeared more effected. This proves that his pyelonephritis is bilateral.

Having failed to check the progress of this lesion in his bladder by the various modes of treatment outlined, sphincterotomy has been proposed to the patient for relief of his residual urine. Should this not bring about the desired results cystotomy will be advised and the destruction of the lesion attempted.



LEUKOPLAKIA OF THE BLADDER

(Valentine)

CONCLUSIONS

1. In this case the lesion seems to be limited to the bladder since the urine obtained by ureteral catheter is free from epithelia which are so persistently present in the bladder urine.

2. From the studies and observation made, the opinion is offered, that leukoplakia usually exists in individuals: (1) who have been subjects of chronic infections of the urinary tract (in this instance, bilateral pyelonephritis); (2) those who have an obstruction to the normal outlet of urine (contracture of vesical neck).

3. Syphilis cannot definitely be excluded as an etiological factor in this case.

4. Concurring with the theory advanced by Kretschmer, Leukoplakia may have existed in this individual prior to his acquiring syphilis or gonorrhea and as a result of these infections the lesion may have been brought into activity.

DIVERTICULA AND CYSTS OF THE URETHRA

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Received for publication January 5, 1923

A few months ago I was given the opportunity to study an unusually large cyst of the scrotum. The nature of the cyst was not recognized until the time of operation when it became apparent that it possessed a pedicle which could be traced into the bulb of the urethra. The pedicle did not join the urethra directly but was traced to a point corresponding in position with the duct of the left Cowper's gland.

In looking through the literature no similar case could be found. Numerous cases of urethral diverticula have been described as well as cysts of Cowper's glands. In reviewing the cases of urethral diverticula and the theories of their causation I was reminded of a certain embryonic stage which I described in connection with my studies on the development of the male urethra (8). This embryo possessed an anomalous condition of the urethra which I believe, if it does not fully explain the formation of diverticula and cysts of the urethra, must certainly throw some light upon the subject. In the following paper I have reviewed briefly the literature on this subject and redescribed the embryological stage referred to above. This is followed by a consideration of cysts of Cowper's glands, and the report of the case of the large cyst of the scrotum, which I believe is intimately associated with the Cowper's gland system.

Under the term "diverticula of the urethra" have been described a great variety of pouches. Some of these are considered congenital, others acquired; some are merely bulbous expansions of the urethra, others are true epithelial-lines pouches; still others are merely false passages made during improper instrumentation of the urethra. In 1906 Watts (13) reviewed the literature on urethral diverticula and classified them as congenital and acquired. Of the acquired diverticula Watts recognized two types, (*a*) those arising from dilatation of the urethra resulting from uretheral calculus and uretheral stricture; (*b*) those arising from perforation of the urethra resulting from injuries of the urethra, ruptured abscesses into the urethra, and ruptured cysts into the urethra. Under the latter caption are considered dermoid cysts and cysts of Cowper's glands.

Of the 16 cases of the congenital type of urethral diverticula which Watts collected, 12 were found to be connected with the pendulous urethra; 2 (cases of Demarquay and Lessing) were found presenting in the perineum; 1 (case of Bokay) within the scrotal sac; and 1 (case of Grube) at the peno-scrotal junction.

In 1908 Ehrlich (3) collected 32 cases of congenital diverticulum. Two of the cases cited by Watts, however (those of Schüter and Petz) are not included in his list. To this list I can add the following cases: a case of diverticulum of the anterior urethra (Haberen (7)); a case of diverticulum of the posterior urethra of doubtful congenital origin (Englander (5)); a diverticulum of the anterior urethra (Denk (1)); a very interesting case of diverticulum with contained stone (Roith (11)). The latter diverticulum was situated within the scrotum and contained a calculus the size of a billiard-ball which completely filled the sac. The sac was lined by an epithelium which was stratified squamous in type. This would bring the total of described congenital diverticula up to 38.

Several theories regarding the formation of congenital urethral diverticula have been advanced. Kaufmann (9) believed that there was a failure to unite of two portions of the urethra, the glandular and the penile. This failure occluded the urinary outflow which resulted in a distention of the urethra. Subsequently when the urethra became patent the distended portion remained as a diverticulum. According to Voillemier (12) diverticulum and hypospadias formation are to be placed in the same category, the difference being that in the former only the urethra is at fault, while in the latter the defect extends through and includes the skin. DePaoli (2) explained the formation of diverticula as due to a primary atrophy of the corpus cavernosum urethrae with a consequent bulging of the urethra into the cavitation thus made on its ventral wall.

Watts states that since acquired diverticula are usually the result of obstruction to the urinary flow, some similar obstruction might be sought for in the explanation of the congenital ones. He says that such obstruction could be caused by adhesions of the prepuce to the external meatus, congenital strictures of the urethra, or by the presence of valves within the urethra. However, he does not believe the findings in cases of congenital diverticula bear out this view and that some other explanation must be sought. Englander (5) supports the view of Voillemier that there is a faulty union of the folds of the urethra. That they may arise as a proliferative growth of the cells on the under surface of the urethra I shall endeavor to show from the condition found in an embryo of about three months old.

The anomalous condition is found in my embryo 82, of 88 mm. crown-rump length. The whole urethra from its internal to its external orifice measured about 14.5 mm. Inasmuch as at this stage the penis is relatively short, the greater portion of the urethra is located within the perineum. The urethra proper is a cylindrical, epithelial-lined tube and patent throughout. The distal end is flattened laterally thus forming a distinct fossa navicularis. The remainder of the urethra is more rounded and its epithelial wall thrown into a number of longitudinal folds. The epithelium is typically embryonic, being composed of several layers of low columnar cells.

On the pubic and to a less extent on the lateral walls are to be found a number of bud-like glands. These vary in size, some are branched, and the majority have their blind ends directed towards the bladder. A few glands of the same type are found on the rectal surface. These glands are, as I have previously shown, the small sinus (Littre) glands of the urethra. Their presence and degree of development are normal for this aged embryo.

On the rectal surface are found in addition to Littre's glands a number of cystic epithelial ducts. Two of these (fig. 1) are entirely cut away from the urethra and lie in the median septum of the corpus cavernosum urethrae, others are attached to the epithelium of the urethra. Together they form a linear series of disconnected tubules paralleling the urethra on its under surface. Some of the ducts are provided with lumens which course throughout their whole length, others with lumens which are broken up and form a number of irregular disconnected crevices.

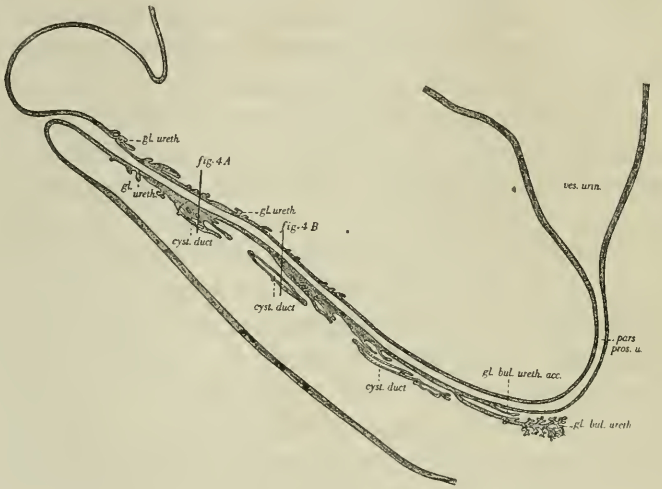

Fig. 1. Urethra of an Embryo of 88 mm. Crown-Rump Length

A graphic reconstruction made from a series of frontal sections showing anomalous ducts on the under surface of the cavernous urethra. *gl. ureth.*, urethral gland (Littre); *gl. bul. ureth.*, bulbo-urethral gland (Cowper's); *gl. bul. ureth. acc.*, accessory Cowper's gland; *pars pros, u.*, prostatic urethra; *ves. urin.*, urinary bladder. Lines A and B indicate level of sections shown in figure 2.

That these cysts are the split-off products of the urethra there can be no doubt. I interpret those which are attached to the urethra as still in the process of formation; just an earlier stage of those which are completely cut away. In figure 2, A is seen in cross-section a duct partially formed; in B one completely cut away from the epithelial tube of the urethra and another in the process of splitting.

The significance and fate of these peculiar structures cannot be determined from this stage alone. I have failed to find anything similar to them in a series of 15 embryos of my own, and 7 belonging to the Carnegie Embryological Collection. The one specimen, however, is definite evidence that the cells on the rectal wall of the urethra are capable of undergoing abnormal proliferation and of giving rise to anomalous ducts. A similar process forming an undetached duct could readily explain the formation of an elongated diverticulum of the cavernous urethra. I present the case, however, not so much to demonstrate a new theory of the formation of diverticula, but in the hope that as other observations are added, the subject of anomalies of the urethra may be cleared up.

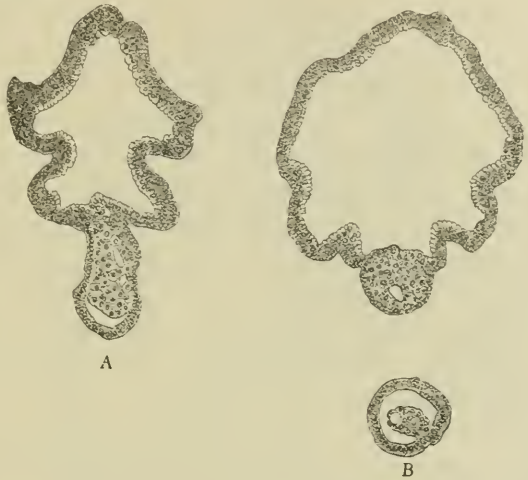

Fig. 2. Cross Sections of the Urethra of Specimen Shown in Figure 1

In A is an anomalous duct in the process of formation; in B, are shown two ducts, one completely cut away from the urethra and one becoming detached.

References in the literature to cysts of the urethra are rarer than those of diverticula and those which I have been able to find deal with cysts of the ducts of Cowper's glands. These cysts arise because of the obliteration of the mouths of the main ducts and therefore lie just beneath the mucosa of the bulbous urethra. Englisch (6) described 5 cases of this kind found both in adults and the newborn. The cysts were all small and presented themselves as bulgings in the floor of the urethra. In one case there were two greatly elongated cysts, bilaterally placed and separated from one another by only a thin wall of tissue. In all of his cases Englisch showed that there was obliteration of the ducts of Cowper's glands.

Elbogen (4) published a report of 16 cases which he found in routine autopsy examinations. They were found in all ages, from infancy to old age. They varied greatly in size, from a few millimeters in diameter up to 6.5 cm. All cases were shown to be due to the occlusion of either one or the other of the ducts of Cowper's glands. Elbogen cites similar cases described much earlier by Morgagni, Forestus, Terraneus, and Gubler. The case of Gubler was found in a full term fetus. It is agreed by all that obliteration of the ducts may be congenital or acquired, the latter usually the result of an inflammatory process. Elbogen believes that the occurrence of such cysts is not so uncommon and that the condition frequently exists without being recognized.

To the above cases of cysts of Cowper's gland ducts I am able to add 3. As two of these are found in fetuses I shall briefly review the normal development of these glands.

Cowper's glands arise as two solid outgrowths of epithelium from the rectal wall of the bulbous urethra. In an embryo of 55 mm. crown-rump length they are already of considerable length, and course bladderward, one on either side of the midline, parallel to the urethral tube. In an embryo 75 mm. the ducts show definite lumens and the beginning of branches. In specimens of 88, 90, and 100 mm. numerous branches are formed and the lumens have grown out into some of the larger branches. At 130 mm. the terminal branching has become extensive and the ducts have pushed upward though the bulb and lie above it. In addition there are developing at this stage several small branches from the main ducts. These branches always remain within the bulb and have been termed the intrabulbous portion of Cowper's glands. In succeeding stages the branching becomes more and more profuse, alveoli are formed at the ends of the branches, and the epithelial cells of the alveoli and certain of those of the main ducts become converted into mucous secreting cells. The further development of the glands consists in merely growth changes in these portions.

As anomalies of the ducts of Cowper's glands are not of infrequent occurrence in the adult, so in fetal stages one finds variations. In specimens of 190 and 320 mm. the duct of the right side alone reached the urethra; in the latter case the left duct had pushed acrossed the mid line and joined the right.

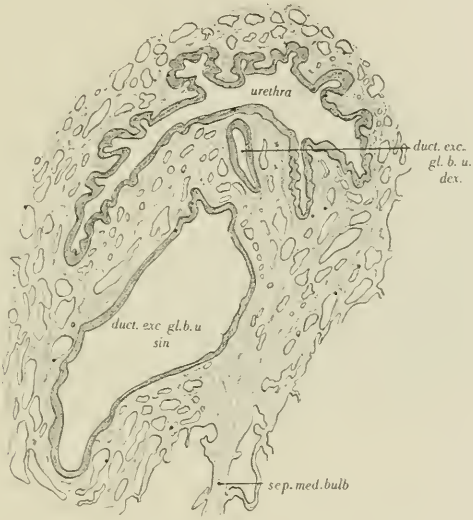

Fig. 3. Cross Section of the Bulbous Urethra of a Fetus 310 mm. Long
The two ducts of Cowper's glands are shown, the left of which is greatly dilated. The mouth of this duct was obliterated.

Cysts of the ducts of Cowper's glands were found in embryos of 310 and 320 mm. These cases are shown in figures 3 and 4. In the latter figure the cyst has become so large that it forms a distinct bulging into the wall of the urethra. In these two specimens are seen therefore, anomalies similar to those found in the adult by Englisch, Elbogen and others.

In addition to Cowper's glands there sometimes develop in the bulbous urethra "accessory Cowper's Glands" (Lichtenberg (10); Johnson (8)). The mouths of the ducts of these glands open into the urethra proximal to those of the main ducts. The accessory ducts are shorter, lie nearer to the urethra than the main ducts but parallel them. The terminal branches are found within the bulb. Lichtenberg found 2 cases of this type and I show 1 in figure 1. These glands are mentioned in this place because the large cyst which I shall now describe may have had its origin in one of these accessory glands. It seems more probable, however, that it started as a cystic dilation of one of the main ducts which gradually forced its way through the bulb and presented in the scrotum.

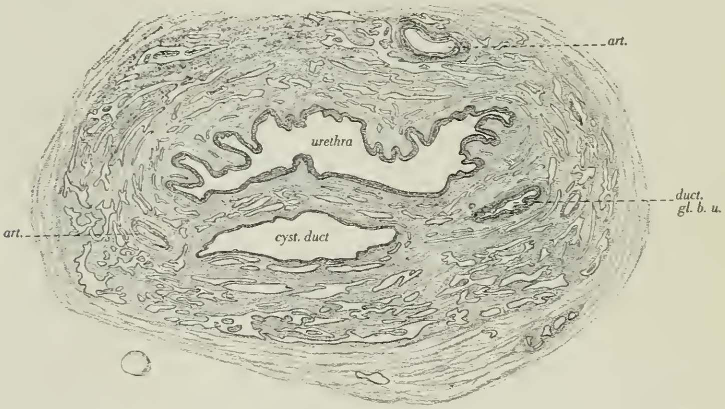

Fig. 4. Cross Section of the Bulbous Urethra of a Fetus 320 mm. long

As in figure 3 the left duct had become obliterated and a cystic condition of the duct resulted.

REPORT OF A CASE

History. The patient, a negro laborer of twenty-two years of age, was first seen by the writer on October 23, 1922. He complained of a large and painful scrotum. His family history was negative; his past history was unimportant except for an attack of gonnorheal urethritis in 1919. From his earliest recollection he had a mass in his scrotum. At the age of six or seven it was the size of a hen's egg. It occupied the middle of the scrotum, the testicles being placed one on either side of it. It gradually became larger and larger until its present size was reached. The patient presented himself at the urological dispensary in 1919 when the scrotum was studied and a drawing made of it. There had never been any pain of discomfort until about four weeks ago when he began to have pain which was mostly in the posterior part of the scrotum and in the perineum. There were no urinary symptoms and the sexual function was normal.

Examination. Physical examination was negative except for the local condition in the scrotum. This was very much enlarged owing to a large cystic mass which occupied the middle of the scrotum. As shown in figure 5 the testicles were placed on either side of the mass, slightly above the middle. The skin of the scrotum was everywhere intact and apparently normal. On palpation there was a moderate degree of tenderness over the whole mass. The left testicle was found to be normal in shape and size; the epididymis was made out only indefinitely, was adherent to the central mass, but showed no enlargement or induration. The right testicle was likewise negative and less adherent and more freely movable over the mass than the left. The large mass occupying the middle of the scrotum was rounded in shape, smooth and about the size and shape of a grape-fruit. It was tense but definitely fluctuant; it failed to transmit light. Comparison with the drawing made in 1919 showed that there had been a definite increase in size.

The patient's urine was uninfected and otherwise negative; the urinary stream was not diminished in size or force. The phthalein test showed an appearance time of ten minutes, 40 per cent secretion in the first hour and 20 per cent in the second. The Wassermann reaction was negative.

Treatment. On October 23, the scrotum was tapped in the dispensary and about 500 cc. of thick grayish-brown fluid was obtained. The cyst largely disappeared but its thick wall did not entirely collapse and could be palpated through the scrotum as an irregular fibrous mass. Smears of the fluid showed a large number of organisms, among which were identified Staphylococcus aureus, Bacillus proteus, and a Gram-negative diplococcus which could not be isolated by plating on account of the large number of other organisms present.

On November 3, the patient again appeared in the dispensary because of pain and general malaise. The cyst was slightly larger than at the previous visit, and showed evidence of pointing at the site of previous

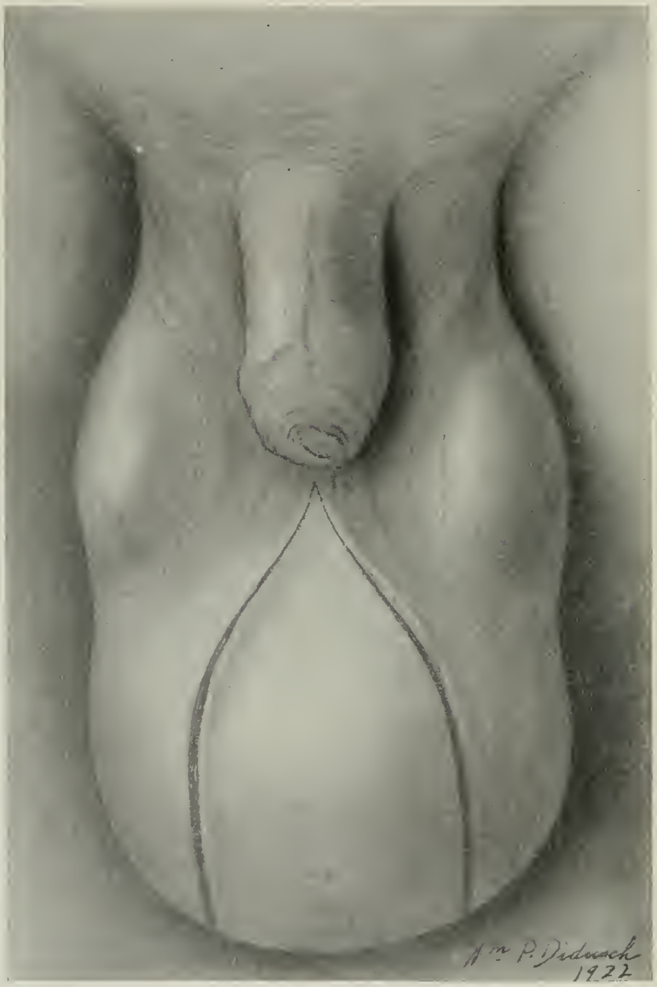

Fig. 5. A Large Cyst of the Scrotum in a Negro 22 Years of Age

The initial incision of the operation is shown. The small area at the lower end of the scrotum is due to a needle puncture made ten days prior to operation.

needle puncture. The patient's temperature was 101°, pulse 100. The leucocyte count was 23,000. He was admitted to the hospital and operation performed immediately.

Operation. Excision of cyst of the scrotum. Ether anesthesia. An elliptical incision was made beginning in the mid-line about one inch below the peno-scrotal junction, circumscribing the anterior wall of the cyst, and terminating in the midline at the scroto-perineal junction

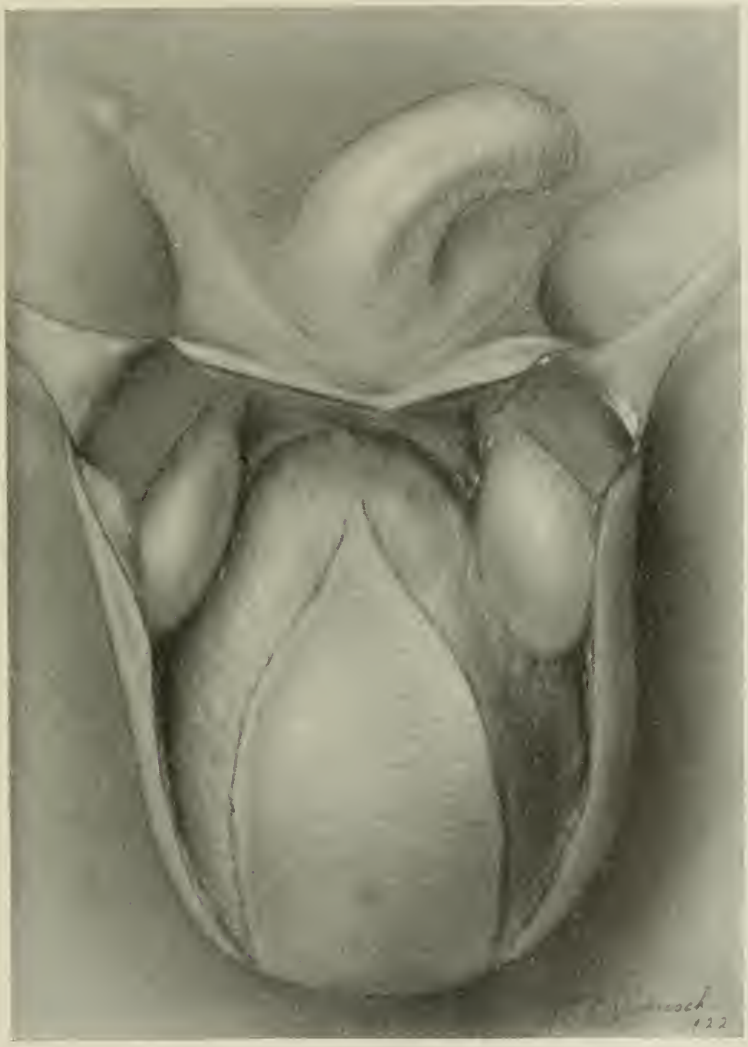

Fig. 6. Exposure and Separation of the Two Sacs of the Tunicae Vaginales

(figs. 5 and 6). A line of enucleation was found close to the dense fibrous wall of the cyst and dissection begun. The two sacs of the tunica vaginalis were separated from the cyst by blunt dissection after considerable difficulty. They were very adherent but neither sac was opened (fig. 6.) Dissection was then continued around on the superior surface where a pedicle was found. As this was followed in more deeply

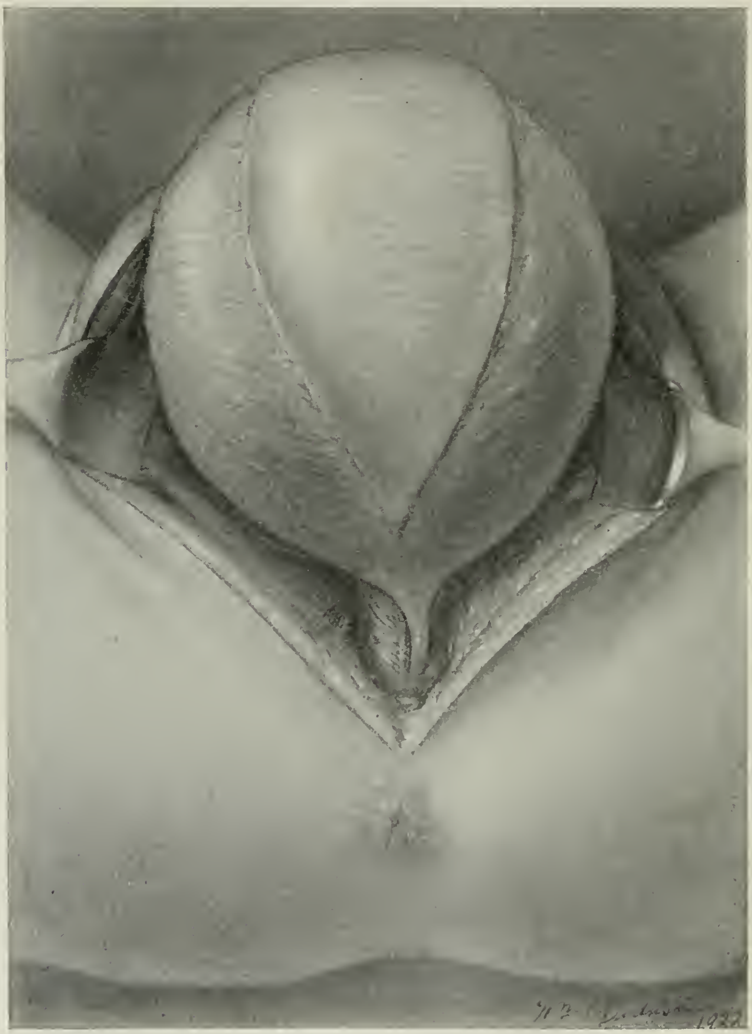

FIG. 7. THE CYST HAS BEEN DISSECTED FREE

The pedicle is seen entering the bulb to the left of the mid-line it became smaller and smaller, attaining a diameter of about 4 mm. The pedicle was traced into the bulb of the urethra to the left of the midline. At this point a sound was passed into the urethra. It immediately became evident that the pedicle was not attached to the urethra directly but had its origin to the left of the midline behind the curvature of the urethra. A hemisection of the pedicle was done but no lumen could be found with a fine probe. The stalk was ligated close to the bulb, cut and the stump cauterized with full-strength carbolic acid. Before closure a considerable amount of superfluous scrotal skin was excised. The two sacs of the tunica vaginalis were brought together in the midline with a few interrupted catgut sutures. Drains were inserted at both the upper and lower ends of the incision. Closure

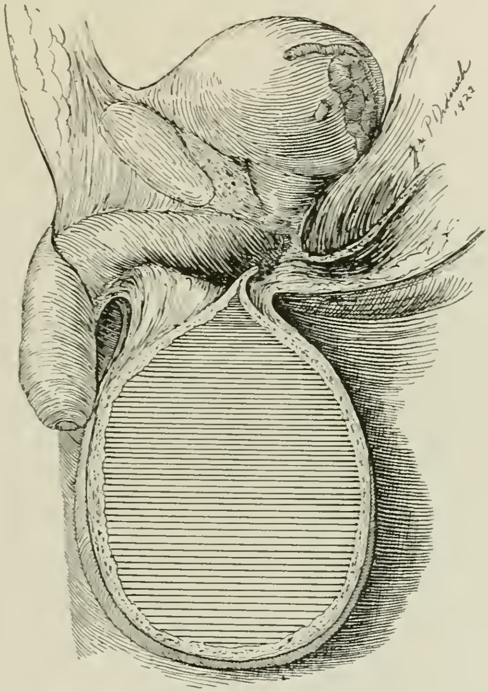

Fig. 8. Semi-Diagrammatic Sketch Showing Relations of the Cyst to the Surrounding Structures

The pedicle is seen entering the posterior part of the bulb behind the curvature of the urethra. It is presumed therefore, that it has its origin in the left duct of Cowper's gland which lies in this position.

was completed with a few catgut subcutaneous sutures and silver skin clips.

Postoperative course. There was a marked improvement in the patient's general condition. The temperature fell to normal on the fourth day. There was a moderate amount of suppuration of the wound. The drains were removed on the fifth day; skin clips on the seventh. The sinuses were irrigated with Dakin's fluid and closed rapidly. The patient was discharged from the hospital thirteen days after operation. The result obtained is shown in figure 9.

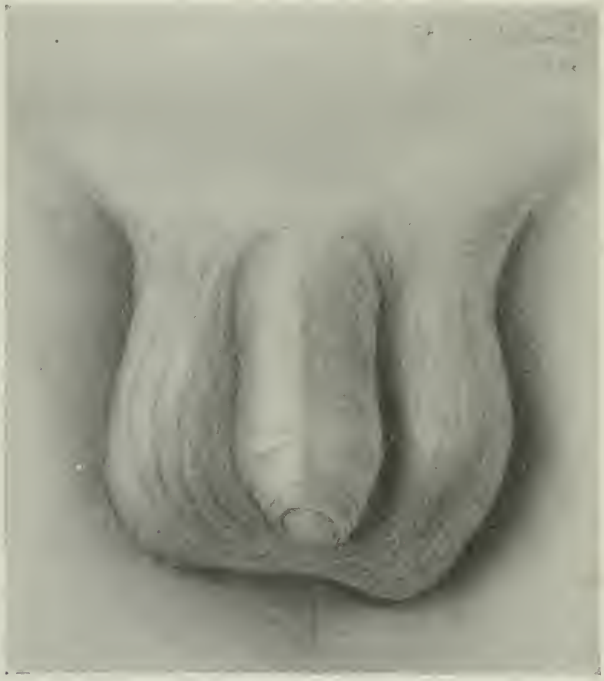

FIG. 9. APPEARANCE OF THE SCROTUM TWO WEEKS AFTER OPERATION

Pathological examination. Examination of the specimen after removal showed a cyst the size of a grape-fruit. Its wall which varied between 3 and 5 mm. in thickness was composed of dense fibrous tissue. The pedicle was short; a lumen could not be found at the point where it had been cut, but there was a blind funnel-shaped opening going down into it for about 1 cm. The cavity of the cyst contained thick yellowish-white pus. Microscopic examination of the wall showed white fibrous and elastic tissue. The epithelium lining the inner surface was in places entirely destroyed; in others well preserved. Two distinct types were found, stratified squamous and stratified columnar. Infiltrating the whole wall, but especially the submucosa, were numerous polymorphonuclear leucocytes, lymphocytes, and plasma cells, indicating an acute process on top of a chronic one. The absence of a lumen in the pedicle was confirmed microscopically. There was, however, a small area of cellular debris and round cell infiltration which could be construed as an obliterated epithelial duct.

That this cyst had its origin in the left duct of Cowper's gland I believe to be substantiated by the position of its pedicle. This led, as I have stated, not into the urethra but into the bulb posteriorly to the urethra. The only epithelial structures normally found in this region are the duct of Cowper's gland, the branches of the intrabulbous portion of Cowper's gland and an occasional accessory Cowper's gland. As not any one of these structures was identified at the time of operation it is to be regretted that the dissection was not carried further, but the patient's condition did not warrant further procedures. The two types of epithelia found, lining the cyst stratified squamous and stratified columnar, throw but little light upon the origin of the cyst. Both types are native to the bulbous, membraneous, and prostatic urethrae (Johnson). The stratified columnar epithelium found differs from that found in the ducts of Cowper's glands only in that in the latter are found patches of mucous secreting cells. It is possible, however, that had not the greater portion of the epithelium of the cyst been destroyed by inflammation, such cells might have been found. Regarding the mode of infection of the cyst nothing definite can be said. Infection may have occurred through a small opening in the pedicle which later became occluded, or it may have been either haematogenous or lymphatic in origin.

CONCLUSIONS

1. Diverticula and cysts of the urethra are discussed.
2. An unusual anomaly of the urethra of an 88 mm. embryo is described. The case is presented as a possible explanation of the formation of diverticula.

3. Two cases of cysts of the ducts of Cowper's glands, both found in fetuses nearing full term, are reported.

4. An unusually interesting case of a cyst of Cowper's gland duct in an adult is described. So far as is known to the author it is the largest cyst of its kind yet reported.

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THE INDICATIONS FOR INDIVIDUAL TREATMENT OF GONORRHEA

WITH SPECIAL REFERENCE TO THE RESISTANCE OR FASTNESS OF THE GONOCOCCUS TO GERMICIDES

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The variation or discrepancy in the action of an individual germicide toward the gonococcus of Neisser in the human body has always been a great puzzle. No one antiseptic has attained a uniform standard as a gonococcocide in this field of direct chemio-therapeutics. True, there are a number of chemicals which kill the gonococcus in the test tube in a few minutes in the same dilution as that well borne by the urethra. Some of them are almost instantaneous in their lethal conduct toward the organism in vitro. Unfortunately, however, the gonococcus in the test tube and the gonococcus in the human body are entirely separate and distinct problems and it is an indisputable fact that no germicide has yet been introduced which is a consistent performer in both places.

A retrospect on medical history makes this fact seem doubly peculiar. From time to time as preparations of new drugs or new methods of using old drugs have been brought to the attention of the profession, hope has sprung forth that, perhaps, an ideal gonococcocide had been found. The results obtained in the experimental or original work with three or four germicides has been of that high order of excellence so closely approximating the ideal that this hope seemed to be properly justified. A review of three of the leading chemicals—potassium permanganate, acriflavine and mercurochrome—employed in the treatment of gonorrhea brings out the fact that the vast majority of cases, treated in the early stages by the originators of these three forms of treatment, were cleared up in an aggregate average of 14.5 days. With potassium permanganate, reference is made to the Janet and Valentine method. It would be a hazardous undertaking to prognose the same results with any one of them today.

It would not seem that individual resistance to the disease or susceptibility to it could be responsible for this wilful disregard on the part of the gonococcus, to the law of germicidal authority, when growing on human culture media. Physiologic chemistry has not demonstrated that there is a difference in the make-up of human beings which can account for the dissimilarity in the action of a certain antiseptic toward the gonococcus in vivo. Certainly, it has not detected a difference in this respect between that resistance which existed twenty years ago and that which exists today. Yet the same uniform treatment results which are accredited to Janet and Valentine are not obtained with permanganate solutions now. It is generally recognized by the profession that, if the urethra be inoculated with an active culture of the gonococcus, a typical infection will follow. Neither partial nor total immunity is seriously thought of.

The question of gonorrheal infections is so vitally important that it might be of interest to discuss this phase of the subject at greater length. Such consideration naturally divides itself into four subdivisions: (*a*) the individual equation; (*b*) previous infections; (*c*) rate and extent of infection spread and (*d*) the causative organism.

THE INDIVIDUAL EQUATION

A patient with a low general physical tone is more apt to suffer severely with a gonorrheal infection than a healthy, normal man. He does not possess the same reserve power which may be thrown into the breach to assist the forces of nature in expelling the invading organisms.

Undoubtedly, the conformation of the urethra has a direct bearing on the manner in which a Neisserian invader deports itself. For example: A patient with a hypospadias, which leaves the dilated urethral glands widely exposed to infection, very frequently presents a deep seated, stubborn complication in these structures which is almost inaccessible and which is very difficult to treat. Congenital and acquired malformations, like stricture, predispose to lasting infections.

The diversity of urethroscopic findings after the subsidence of gonorrheal infections clearly indicates that there is a radical difference in the manner the invasion is resisted by individual urethrae. In some there is a readily defined pathology around the crypts and orifices of gland ducts while, in others whose initial symptoms were equally acute, the urethra is normal. This one instance shows that the urethra is more prone in some patients to permit a glandular, follicular involvment than in others and, for that reason is more liable to harbor a deep seated, resistant infection.

PREVIOUS INFECTIONS

Previous infections are not indicative of acuteness in succeeding attacks though they may tend to longevity. A second or third infection is very often subacute from the onset, but, if the urethra has been very much damaged by previous infections, the disease may hide in the recesses prepared for it, such as patulous gland ducts or behind a stricture. It is at times a relief to see a patient who has harbored a stubborn, chronic infection fall from grace and return with a frank, fresh, acute attack. The entire morbidity is quite frequently cleared up in a short time under such conditions.

Initial infection and initial acuteness do not indicate that treatment results will be either rapid or uniform. Carefully compiled records of the disease in healthy young men who present an initial infection and who are treated under exactly the same conditions and surroundings and with the same remedial agents, reveal the fact that the time required to effect a clinical cure varied to a marked degree. This time varied alike for those in whom the infection was limited strictly to the anterior urethra and for those in whom the posterior urethra and adnexa were involved.

RATE AND EXTENT OF INFECTION SPREAD

A virulent infection spreads so rapidly at times that it involves the entire urethra before it can be gotten under control. Statistics give involment of the posterior urethra in from 40 to 90 per cent of cases. It is but a short infection step from the posterior urethra to the prostate and it is rare indeed, in the opinion of the writer, that an acute inflammation of the former is not associated with a corresponding prostatitis. The patient is fortunate if he escapes a vesiculitis also. Once these structures become invloved, the disease may persist indefinitely.

THE CAUSATIVE ORGANISM

The gonococcus does not immediately upon implantation on the mucosa penetrate to the submucosal tissues. The mucous membrane is a natural defensive barrier to the entrance of any bacteria and there must be a solution of continuity before it can burrow deeper. The hitherto intact membrane is first eroded by the process of inflammation. The time for this erosion varies according to the virulence and aggressiveness of the causative microbe. It would appear perfectly reasonable to infer that the action of a germicide of known potentiality should be fairly constant and uniform while the inflammatory process is superficial, limited in area and therefore readily accessible to the drug. Yet the results in the abortive treatment of gonorrhea compiled from cases in which the treatment was begun immediately upon the appearance of the first symptoms are by no means the same. The abortive treatment is not successful in a number of cases administered under apparently ideal conditions. Therefore, it does not seem to be a radical assumption that the reason for failure not only in the abortive treatment but also when the disease has advanced beyond that stage in which it is indicated, must, in a measure, lie elsewhere than with the drug employed or with an individual equation. The difference in the time required to effect a cure in two patients suffering with the same morbid involvment—be it anterior urethritis, prostatitis, vesiculitis or what not—and treated with the same remedial agents is strongly confirmatory of this assumption.

Wright and other research workers have demonstrated that there are twelve or more different strains of gonococci. This fact is negligible for the purpose of routine office diagnosis since it takes a laboratory expert to isolate them. It might be that different strains of the organism react differently to a given chemical. This possibility has been referred to in literature but it is a wide conjecture to attribute a selective affinity so keenly discriminatory to individual groups of a family of microörganisms as closely and intimately related as these strains must be.

Syphilographers are advancing the contention that the sphirochete pallidum quickly becomes arsenic and mercury fast when continuously subjected to the influence of these two drugs. By fast, they mean that the spirillum develops a resistance to anti-syphilitics which practically neutralizes their sterilizing properties. Basing the procedure on comparative results, they do not give both drugs at the same time. The sphirochete does not stay fast to either drug indefinitely. By the time it has become accustomed to the effect of one of them the other is begun and its use continued until the organism has thrown off its fastness to the first employed. The shift is made in this manner ad infinitum so that the germ is at all times being attacked by the preparation against which it has but feeble resistance.

Another instance of this defensive ability on the part of bacteria which occurs in urology may be cited. A pyelitis at times improves rapidly if the reaction of the urine is sharply changed. The alternate use of acid and alkaline urinary antiseptics is a well recognized procedure in the treatment of pyelitis. Whatever the causative organisms may be, they seem to possess a ready adaptability to changing environment.

May it not be that the gonococcus becomes fast in the same manner to the agents used to accomplish its destruction? May not this fastness partially account for the mysterious diversity in the killing influence of gonococcocides as a whole?

Dwelling a moment on the history of any one popular gonococcocide, this does not seem so very wide of the mark. Take acriflavine, for instance. Immediately upon its appearance, the glowing accounts of its initial success swept it into instant popularity. It was used in all parts of the country as quickly as the manufacturers could supply it. The reports from the results of its wholesale usage during the first year were exceptionally fine. These results seemed to be less striking in the second year while in this—the third year—it is regarded in many quarters with no greater favor than drugs resorted to before its advent.

If dependence may be placed in contemporaneous literature, there must be a difference in the deadliness of this compound toward the gonococcus today from that recorded three years ago. This difference either lies in the purity of the preparation manufactured at present or else in the defensive powers of the organism against it—the probability being strongly in favor of the latter.

If it is true that the gonococcus becomes fast to various chemicals, then it can be readily seen that the more universally a given one is used, the quicker the reaction against it will take place. When it is producing better results than the others, it will be resorted to almost to the exclusion of its fellow germicides. Gonococci circulate in a community at a rather rapid rate and a considerable degree of resistance can be quickly built up against a drug which the majority of physicians are using to combat the disease.

Since the gonococcus multiplies by direct cell division, it would seem that the individuality of the parent relative to fastness would be directly transmitted to the offspring, the degree of fastness being in inverse proportion to the number of subdivisions, and that this fastness would persist until the subdivisions become numerous enough to make it a negligible quantity. This fastness does not seem to persist indefinitely. It probably develops faster than it fades away. It seems to develop with the silver derivatives quite often in seven or ten days.

Comparison between the results reported by the men doing the orginal work with new preparations and treatment methods and those obtained by the same treatment today greatly strengthens the inference that such fastness does exist.

Janet claimed a cure in three weeks with irrigations of permanganate in most cases seen early. Many responded sooner than that.

Valentine says of his modification of the same system, "No other method can show 90 per cent of cures in fourteen days."

In the orginal series of fifteen cases treated by Harrell and Davis with acriflavine, the infections were all cleared up in sixteen days, with an average of $6\frac{14}{15}$ days.

Using mercurochrome, Young was able, in one hundred cases of acute specific urethritis, to render the discharge microscopically free from the gonococcus in an average of 16.8 days.

From this we see that the average number of days it took these men to kill out the gonococcus with the three above mentioned methods of treatment was an aggregate of 14.5 days. Only a venturesome man would definitely prognose the same results with any of these methods today. Certainly no one would do it with either the Janet or Valentine irrigations or with acriflavine. Mercurochrome is nearer to therapeutic infancy and for this reason alone may run truer to form than the rest. The writer predicts that mercurochrome will not long remain consistent, if, indeed, it has not proved itself otherwise by this time.

The writer is thoroughly convinced that the gonococcus becomes fast to germicides used locally. For this reason he gravely doubts if the ideal gonococcocide will ever be found which can stand the test of time.

Observation of the behavior of gonorrheal infections seems to warrant the conclusion that this fastness may be of two kinds.

a. That which is acquired while the person transmitting the infection is being treated and which, therefore, existed at the time transplantation took place.

b. That which is developed during treatment but which did not exist at the time infection occurred.

To confirm the inference made in subdivision (*a*) attention is again directed to the average number of days in which theurethra was sterilized to the gonococcus when acriflavine was first used. The average was a fraction less than seven days. By using the same amount of the drug in like concentration and at the same intervals, this cannot be done today with the same uniformity. Many cases do not respond at all favorably and prudence requires a shift to another germicide. If acriflavine is the drug indicated, it will do its work quickly. This is true of any drug. Brilliant results, like those quoted by Valentine, may follow the use of permanganate solutions in some cases, while other cases in which this solution brings about a slow response will quickly yield to protargol or mercurochrome. The drug which is best suited to the needs of the individual case will bring forth a quick response. If its action is not rapid, there is something wrong. As before suggested, after eliminating the personal equation, it might be that the strain of the gonococcus is responsible but this is hardly possible. The other contingency is, that somewhere somehow the organism has acquired a mysterious protection against the drug.

An occurrence which led to the inference made in subdivision (*b*) is noticed when any drug is used. Take protargol for example. An acute urethritis may respond beautifully to that drug for a week or ten days and then there is a sudden heightening of all the acute symptoms and a rapid spread of the disease. What can the solution of this be but that the drug has ceased to hold the gonococcus in check for the simple reason that it has lost its potency towards it? The personal equation being the same as at the beginning of the infection and the strength and purity of the solution being the same, the answer seems to lie with the gonococcus. A shift to another chemical may very quickly bring the inflammation under control again.

Since the tentative recognition of the theory of fastness in this office, the treatment results in gonorrheal infections have been noticably better. Generous recognition is gladly accorded the recent additions to the threapeutic armentarium in making this statement. No one drug, however, is relied upon to produce results. A report on the treatment results with a series of cases of acute gonorrhea is now being prepared for publication. This article has been too lengthy to touch upon it now.

In conclusion if must be said that the infinite diversity of the problem of gonorrheal infections imperatively demands the closest association of physician and patient. Every aspect of the disease inevitably confirms the contention that each separate case must receive the individual attention and the personal supervision of the attending physician. In no other way can the diverse elements entering into this great complex be intelligently dealt with. Modern urology has proved beyond a doubt that there is no comparison, whatever, between the results achieved when the patient is so cared for and those when he is fitted out with syringe and solution and allowed to shift for himself. In truth, the gravity of the disease makes it a major problem in the practice of medicine. The vast army of sterile, strictured, crippled, neurotic victims of the disease is incontrovertible evidence in support of this statement.

A RARE CASE OF SCHISTASIS

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Received for publication March 12, 1923

Incomplete union of the fetal arches is not extremely rare and gastroschisis is very often seen. Usually when the lower abdominal wall fails to close it is found that the lateral walls of the bladder and the penis likewise fail. I have searched the literature for a case where the lateral lower abdominal arches failed to close without bladder defects and for a case where the rectum and sigmoid were external to the body. Such a case is herewith reported.

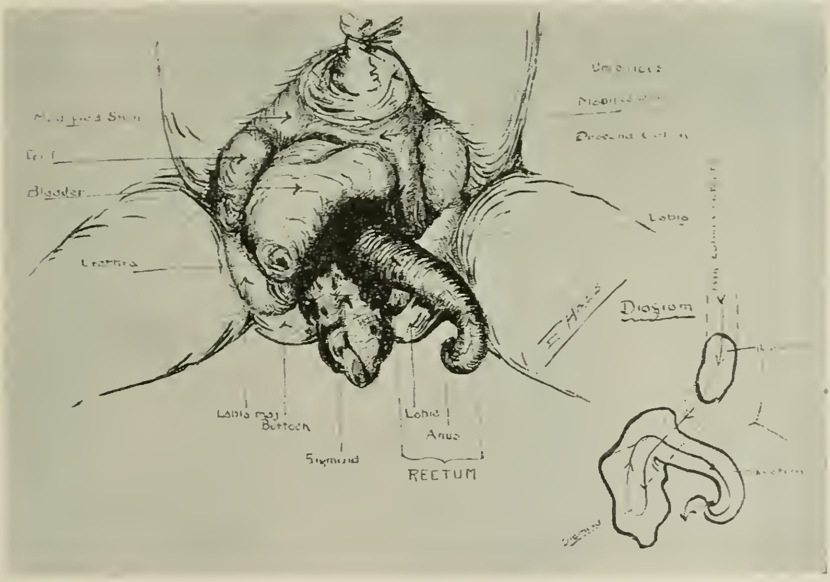

FIG. 1

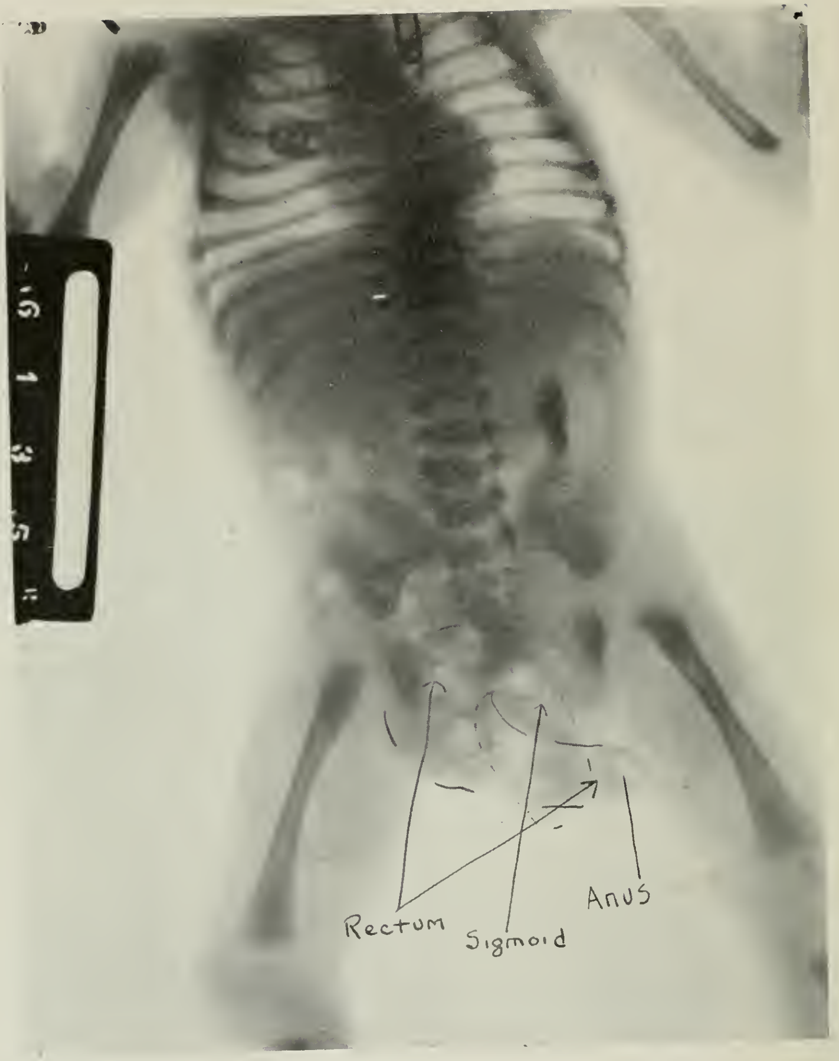

FIG. 2

At the time of birth the obstetrician, making a hasty survey of the child, thought he had an ordinary case of extrophy of the bladder with the scrotum and penis without the usual covering of skin. Imagine his surprise when he carefully examined the child to find that the supposed penis was the terminal rectum and the part that seemed scrotum was sigmoid.

The development of the child was perfect until the umbilicus was reached. The entire lower segments of the lower abdomen had failed to close. There was some modified skin just below the unbilicus and two soft masses presented to the lateral sides of the bladder, which was perfectly formed and capable of holding about 20 cc. of urine. The sphincter control was excellent and there was a short urethra. Directly below was a tube about 6 cm. long which reminded one of a penis, connecting at the bladder with a larger mass which proved to be the sigmoid. This bowel mass presented through the definite labia which seemed to spring from the tissues at the tip of the coccyx. The X-ray showed complete absence of the pubic bones. The uterus was normally situated but its cervix presented blind between the bladder and the rectum and was totally confined inside the abdominal cavity. There was no obstruction to the passage of ingested food and the urinary organs functioned normally. The infant died on the 11th day and because of the unusual features is considered rare enough to warrant its being reported.

SPONTANEOUS EXPULSION OF PAPILLOMA OF THE BLADDER WITH CURE

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Spontaneous expulsion of a tumor of the bladder by urethra is such a rare occurrence that a search of the literature has failed to reveal a case identical with that reported herein, although similar cases have been reported. Ewing and Nitze remark the possibility of spontaneous cure, and Judd mentions a case of spontaneous cure of a small pedicled tumor which passed entirely away. Bruhl observed a case of spontaneous expulsion of a vesical tumor through a perineal wound. At operation the surgeon had caught a growth, but after further manipulations was unable to find it again. About seven hours later, however, the patient passed a papilloma about 5 by 2 by 2 cm. In none of these cases has sufficient evidence been presented for the tumor to be definitely classified as spontaneously expelled with a resulting cure.

REPORT OF CASE

Mr. W. M., aged twenty-one years, was referred to me at the Jackson Clinic by Dr. Carleton, of De Forest, Wisconsin, March 10, 1922. The patient had been perfectly well until March 6 when he suddenly developed acute retention of urine. The doctor who catheterized him noticed that the urine did not run through the catheter very well, but when the instrument was forced well back into the bladder the urine flowed through the urethra around it. The patient was again catheterized the same evening and the next morning. On the afternoon of the second day he passed a tumor through the urethra (fig. 1). Expulsion of the tumor caused considerable pain, but blood was not passed either before or after the tumor.

General physical examination March 10, revealed nothing of importance. Urinalysis showed a specific gravity of 1.018, reaction acid, a trace of albumin, a few red cells, and considerable pus. Cystoscopic examination by both direct vision and lens cystoscopes revealed nothing more than a mild acute areal cystitis 1, on a scale of 1, 2, 3, 4. The point of origin of the tumor could not be located. Both ureteral orifices appeared normal, and a thorough inspection of the entire mucosa of the bladder as well as the entire length of the urethra showed nothing of a pathologic nature, except the mild cystitis. Both ureters were catheterized and a small amount of pus was found in the urine from both kidneys. Treatment consisted in lavage of the bladder and pelvis. The patient was kept under observation for a month and at the end of that time he appeared perfectly normal.

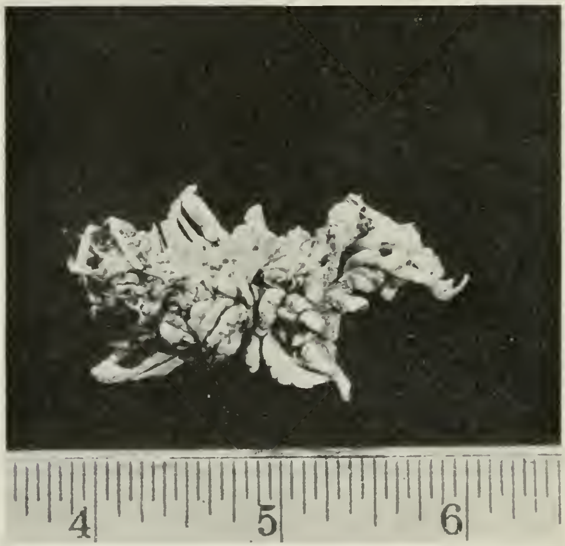

FIG. 1. PAPILLOMA OF THE BLADDER EXPELLED THROUGH THE URETHRA

Dr. C. H. Bunting, of the University of Wisconsin, rendered a pathologic report on the specimen as follows:

"The specimen consists of a much branched papillomatous tumor which, after fixation, forms an irregular brush-like, elongated mass roughly 2 by 6 by 1.5 cm. The tumor appears to have been attached along a narrow ridge, approximately 3 cm. in length and 5 mm. in width at its widest part. The mass of the tumor is made up of the many papillae which vary much in length and in shape. At one end of the mass, the papillae are long (2.5 cm.), filliform, and both branched and without branches. At the other end, the papillae are short (1 cm.), flattened, and leaf-like, some simply ovoid, others ovoid and notched. The majority of the processes are polypoid (club shaped) in places with smooth contour, in others, lobed and knobbed.

"Histological examination of numerous papillae fails to reveal any surface epithelium. It appears to have been desquamated from the entire tumor. The papillae show a vascularized connective tissue stroma with poorly staining nuclei in the cells, apparently the result of beginning postmortem necrosis."

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UTERO-VESICAL FISTULA

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After perusing the literature dealing with urinary fistulae, we conclude that the occurrence of utero-vesical fistula appears far less frequently than the well known vesico-vaginal variety. The following case presented this rather rare type of fistula, and the interest it awakened in making the diagnosis proved it of sufficient interest to place upon record, together with illustrations of the operative method used in affecting its cure.

The patient, Mrs. M. B., married, aged thirty-two years, complained of frequency and urgency of urination and pain in the back.

Family history. Negative.

Past history. The patient is of Polish descent and speaks practically no English. However, there appears nothing of serious moment until an operation in 1916, which will be considered in describing the present illness.

Martial history. Husband alive and well. Has one living child. Two stillborn.

Menstrual history. Began at fourteen years and was entirely normal up to the time of her operation in 1916 and has ceased since then.

Habits. Appetite poor. Bowels constipated. Sleep much disturbed by frequency of urination which is every hour or less day and night.

Present illness. Dates from 1916, at which time she entered the Buffalo General Hospital for Caesarean section after having been in labor for three days. Her condition was extremely critical; and upon opening the abdomen, the uterus was found ruptured with the dead fetus lying free in the abdominal cavity. Hysterectomy was performed at the line of tear just above the cervix. The patient recovered after a stormy convalescence.

At the time of her discharge from the hospital it was discovered that urine was leaking from the vagina. Three months later the patient reentered the hospital for repair of the supposedly vesico-vaginal fistula. Operation was performed without benefit. In February, 1922, Mrs. M. B. was admitted to the Buffalo City hospital complaining of the urinary symptoms and a large ventral hernia at the site of her former operation. The hernia was repaired and a large cystic ovary removed, from which recovery was uneventful.

Previous to this operation two cystoscopies were performed by different members of the urological staff. The findings of both examiners were identical, namely, a small opening in the bladder just above the interureteric ridge, and slightly nearer the right ureteral orifice than the left. The opening was thought by one observer to be a third ureter. However, both right and left ureters were easily catheterized. Phthalein intravenously appeared simultaneously from both sides in three and one-half minutes; but none appeared from the third opening in half an hour. The other observer concluded a diverticulum was present as an X-ray of the pelvic region after a ureteral catheter had been passed through this opening appeared coiled up behind the bladder. Thorium was then injected throuth the catheter, and a cavity about the size of a hen's egg was demonstrated upon the next plate.

A cystogram was then made, which showed nothing unusual (fig. 1). Finally, the bladder was emptied and a plain X-ray taken, which showed no thorium remaining in the supposed diverticulum, leading to the conclusion that drainage was perfect and therefore the diverticulum was not responsible for the urinary symptoms present. These were explained by the mild trigonitis and cystitis present and operation upon the hernia advised.

In May, 1922, the patient was referred to our service from the Out Patient Department of the Buffalo City Hospital still complaining of the same urinary symptoms. Cystoscopy confirmed the findings already recorded, and several local applications of silver nitrate were made to the trigone and urethra without benefit.

An interpreter was requested at the next examination and the diagnosis practically established by the patient saying "My trouble is that I leak urine from my womb, and go frequently to void to keep from getting wet."

It is strange that in a careful perusal of the bedside notes no mention of this condition at the time of operation was made, the notes simply stating that the patient had considerable leucorrhea. The history notes while mentioning the operation performed at the Buffalo General Hospital failed to mention the reason for it, due no doubt to the difficulty in obtaining the history.

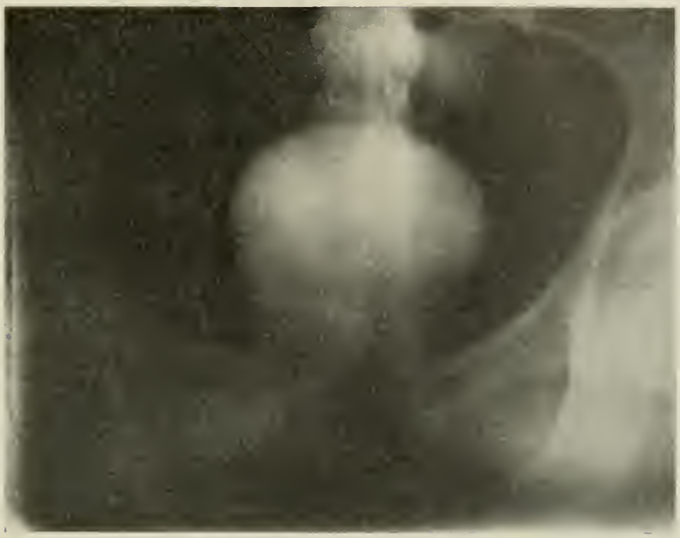

Fig. 1 Normal Cystogram of Bladder

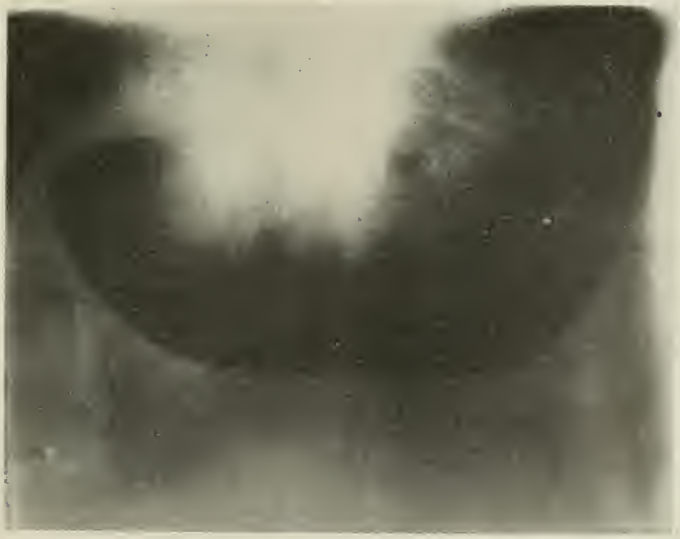

Fig. 2. Catheter Passing Through Urethra, Bladder and Fistula Emerging from Vagina

Pelvic examination shows a profuse discharge, a moderately sized cervix quite severely lacerated, together with a very small uterine body. No masses could be felt in either side or in the cul de sac. A bi-valve speculum was introduced and upon moving the cervix with one of the blades jets of urine were seen spurting from it A cystoscope was then passed and a catheter introduced through the third opening. The

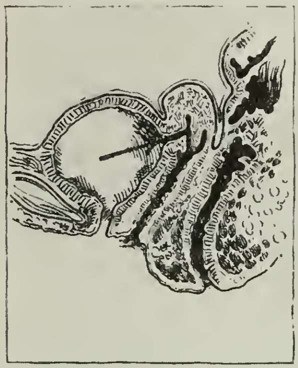

Fig. 3

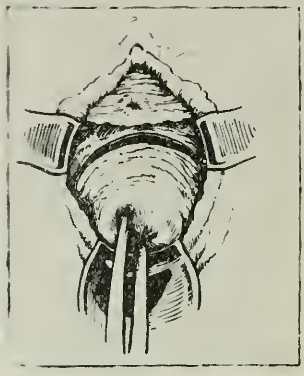

Fig. 4

Fig. 3. Site of Fistula Illustrated
Fig. 4. Operation for Repair. Incision

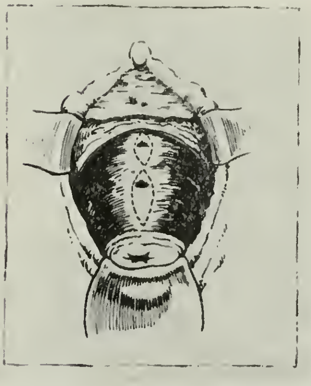

Fig. 5

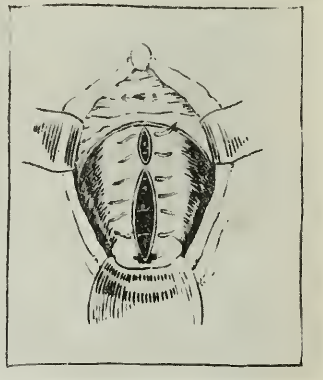

Fig. 6

Fig. 5. Operation for Repair
Fistula in bladder and uterus exposed with dotted lines showing areas excised
Fig. 6. Sutures Placed in Closing the Bladder and Uterus

catheter promptly appeared through the cervix passing on into the vagina, making it evident that a true utero-vesical fistula was present, the exact condition being well illustrated by the following cuts (fig. 2).

Laboratory analysis. Hemaglobin 80 per cent. Leucocytes 7450. Differential polymorphonuclears 78 per cent. Large lymphocytes 10 per cent. Small lymphocytes 10 per cent. Esinophiles 2 per cent.

Urine analysis. (Catheterized sample.) Acid. Specific gravity 1008. Cloudy, amber. Albumen and sugar negative. Microscopic. Many squamous cells, scattered pus cells, numerous Gram-negative bacilli (fig. 3).

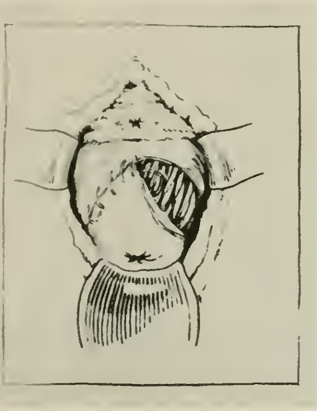

Fig. 7. Final Closure Showing Muscle and Fascia

Pad placed between sutures in the uterus and bladder and the vaginal mucous membrane.

Operation. May 3, 1922. Catheter passed through fistula by the cystoscope. Nitrous oxide-ether anesthesia. Lithotomy position. Cervix exposed and held by double tenaculum. Transverse incision (fig. 4) just above the cervix carrying the same well down beneath the fascia, which was separated by blunt dissection from the uterus. The fascia was very thin and the bladder was entered about 1 inch above the cervix at the site of the fistula (fig. 5). The scar tissue was excised from the bladder opening and the latter closed by plain 0 catgut sutures so placed as not to penetrate the mucous membrane. The cervix was next split anteriorly, the scar tissue excised and the incision closed with interrupted 0 chromic gut sutures (fig. 6). The fascia was closed with interrupted 0 chromic gut sutures, used double, in such a way that the line of sutures resembled the usual inverted Y perineal incision (fig. 7). This maneuver placed fresh tissue between the lines of suture in the bladder and cervix, a point in our opinion of the greatest importance. The mucous membrane was closed with 0 plain gut. The bladder and vagina irrigated with 1:1600 mercurochrome and a light packing of gauze soaked in this solution left in the vagina for twenty-four hours. A small pezzar catheter was placed in the bladder for continuous drainage.

Post-operative notes. The patient reacted nicely. The pezzar catheter did not work especially well and was removed in forty-eight hours; the vagina was irrigated daily with 1:1600 mercurochrome solution. There was slight urinary leakage for about forty-eight hours, after which this ceased and there has been none since.

The patient was last examined November 2, 1922. At this time she was enjoying good health and was starting to work as a cleaning woman, her former occupation. There was no urinary leakage from the vagina, the bladder urine was clear and negative upon examination. The frequency was about normal and she considered herself well.

THE SURGICAL PATHOLOGY OF ACUTE AND CHRONIC EPIDIDYMITIS[1]

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AND

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The surgical treatment of acute epididymitis is not an entirely new procedure. In his treatise on venereal disease published in Paris in 1853, Vidal de Cassis is absolutely enthusiastic on the subject of puncture for the purpose of relieving, quickly and promptly, all the symptoms of this painful disease. The surgeon to whom Vidal de Cassis and other authors give credit as having first used this treatment is Velpeau. In an article on the testicle in his "Dictionary of Medicine," Velpeau described his method which consisted of puncture of the tunica vaginalis.

In the "Lancet" for 1864 Henry Smith reported 20 cases which were treated by him by a "careful incision made into the highly inflamed organ by a thin, sharp blade, being careful not to incise the testicular substance." He evidently is the first, or at least, one of the first, who deliberately made an incision instead of employing puncture. In a subsequent article published in 1876, he stated that a similar operation was previously done (quite unknown to Smith at the time of his first publication) by Pirogoff in 1852.

Bumsted and Taylor in their "The Pathology and Treatment of Venereal Disease," published in 1883, spoke of the operation as the golden opportunity for giving almost instantaneous relief and cutting off further progress of the disease. T. W.

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[1] Read at the annual meeting of the American Urological Association, Rochester, Minn., May 21 to 23, 1923.

Numm in 1876, advised multiple puncture of the tunica and inflamed organ, acting on the same principle that iridectomy is performed in acute glaucoma. Bloxom, in 1876, reported trocar-cannula puncture of several cases, with relief. Cumston, in 1898, made the statement that if you incise the abscess of the epididymis in time or open the tunica albuginea, the course of the suppurative process will, most likely, not be very serious and a cure will take place promptly.

Belfield, in his Presidential Address before this association in 1909, advised incision of a non-fluctuating epididymis and the tunica vaginalis, which procedure, according to his statement, was also introduced independently by Escat. Belfield's first publication on this subject was in April, 1905. He used the same incision to inject at the same time the vas deferens and the seminal vesicle.

The widespread interest in the surgical treatment of epididymitis, however, dates from 1906, following the publication of Hagner of Washington, since which time the question of the surgical treatment of acute epididymitis has been actively taken up by the genito-urinary surgeons all over the country. During the same year, Bazet of San Francisco also published an article on the same subject. Since then epididymotomy has been more or less widely used, among its warmest advocates being Major Allen, C. S. Vivian and many others.

In view of the fact that epididymitis is a relatively frequent complication and as most cases get well without surgical treatment, we are of the opinion that cases of acute and chronic epididymitis should be rather carefully selected for operative treatment. In other words, not every patient who has epididymitis should be operated upon. On my service at the Alexian Brothers Hospital, the patients are given the benefit of non-operative treatment before the question of surgical intervention is discussed. This consists chiefly of rest in bed, applications of very large hot wet dressings, support of the parts, and the use of hot Sitz baths. After the patient has been on this regime and in case he does not respond to this form of treatment, the advisability of surgical treatment should then be discussed. The

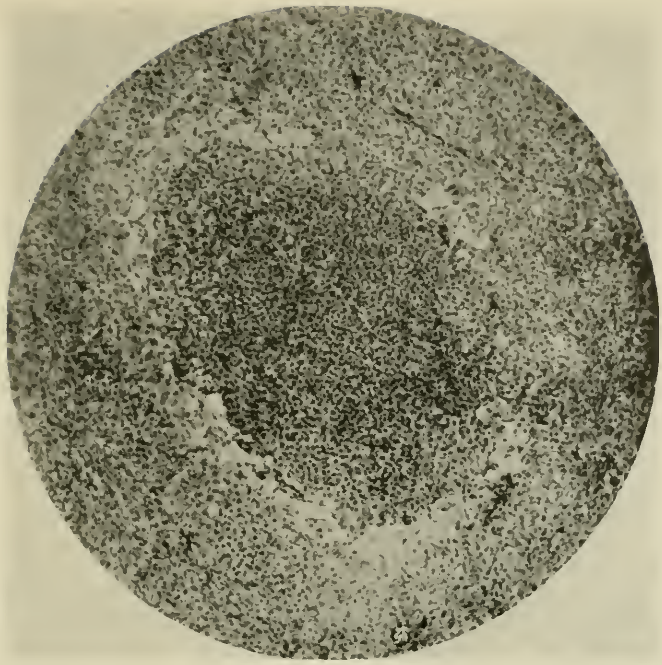

Fig. 1. Polymorphonuclear Abscess Completely Filling and Destroying the Tubule

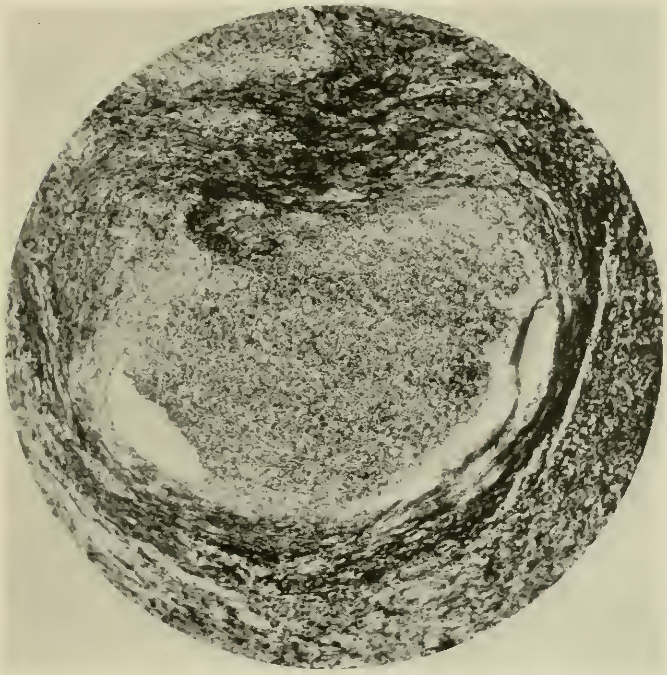

Fig. 2. Complete Destruction of Lining of Tubules by Polymorphonuclear Leucocytes

indications which we have followed for operating on cases of acute epididymitis are the following:

1. Failure of the above local treatment.
2. Presence of pus, that is, if upon admission to the hospital fluctuation can be demonstrated, showing clearly the presence of an abscess, operation is carried out immediately.
3. If, in spite of the above outlined local treatment and conservative management, the pain persists or increases, if the swelling increases and if the patient's leucocyte count is high or increases during the time he is under observation, surgical treatment is advised.

The cases of chronic epididymitis included in this series that were treated surgically, were operated upon chiefly because of the persistence of pain and because of the presence of a hard, thickened, tender epididymis.

PATHOLOGY

While most of the publications deal with the surgical treatment, few detailed reports of the surgical pathology are to be found in the literature. Several years ago Cunningham and Cook reported a series of 25 cases in which they carefully described the pathological findings.

In this series of 37 cases of both acute and chronic epididymitis, the disease was bilateral in 3 instances, making a total of 40 epididymes which were available for histological study. In view of the fact that there was an essential difference histologically between the acute and chronic cases, it would seem proper to describe the pathology of each type of epididymitis separately.

This paper will not consider or discuss the pathology of tuberculosis of the epididymis.

Acute epididymitis

There were 26 cases of acute epididymitis. Of this number, 2 cases (1 bilateral), as far as could be determined, were of non-venereal origin. One patient suffered with chronic retention of urine due to tabes dorsalis, necessitating daily catheteri-

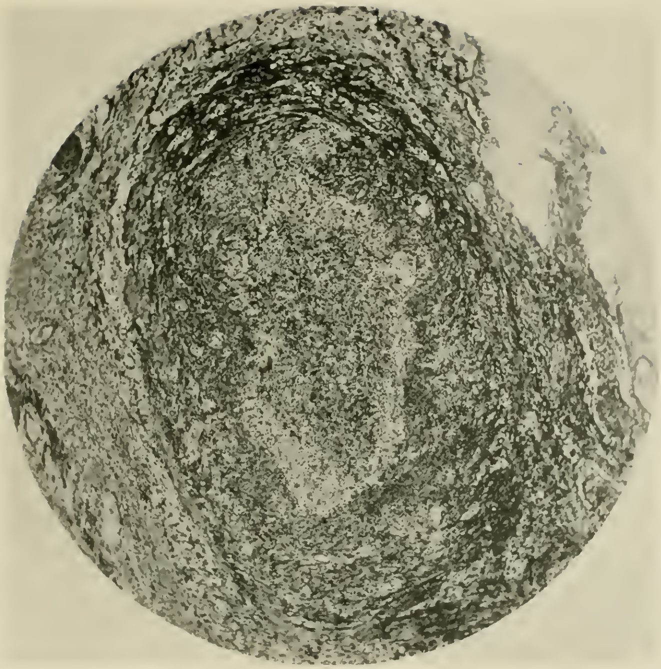

FIG. 3. SHOWING COMPLETE DESTRUCTION OF TUBULE BEYOND ALL POSSIBLE REPAIR WITH RESTITUTION OF TUBULE FUNCTION

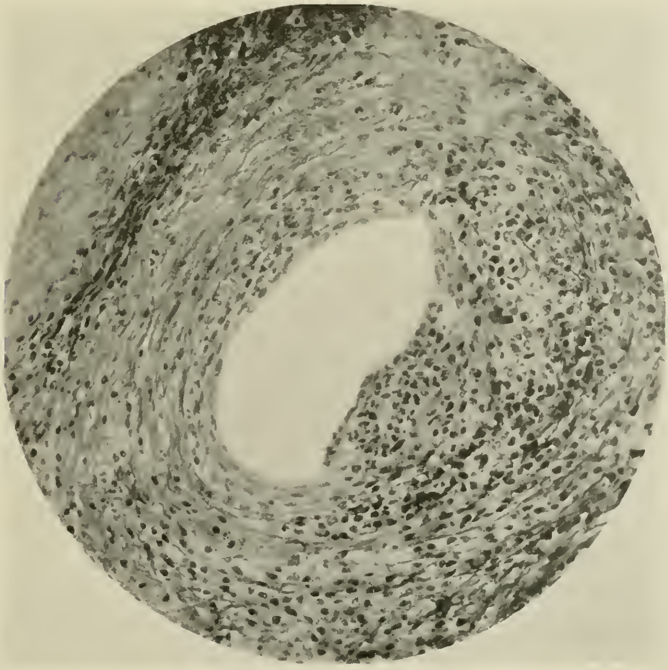

FIG. 4. LEUCOCYTIC INFILTRATION OF WALL OF TUBULE WITH ABSCESS FORMATION

zation. In the other patient, the epididymitis, as far as could be determined, was traumatic in origin. There were 24 cases of acute gonorrheal epididymitis.

Since the histological picture was the same in the venereal and non-venereal cases, the histopathology of both types will be discussed together.

There were scrotal changes, varying only in degree, in nearly all the cases; hence, occasionally only slight changes were noted. The time of operation and the time that had elapsed between the time of examination and operation, influenced these changes, which, when marked, consisted of redness, swelling and edema. Not infrequently the scrotum was adherent to the epididymis so that the latter was visible upon inspection (periepididymitis?). At other times the involvement of the scrotum and epididymis was evident only upon palpation.

Hydrocele fluid was present in 21 cases. This varied in amount from 1 or 2 cc. to 30 cc.

A fibrinous exudate was noted 18 times at operation. Its distribution varied; at times it covered the epididymis only and sometimes it extended onto the body of the testis, and again, it was found on the parietal layer of the tunica and when pulled off a bleeding surface was left behind. In several cases, in which a careful study was made, gonococci were found in the exudate. At times the exudate was very marked and when it formed on both layers of the tunica vaginalis, agglutination followed, so that the space normally found between the layers was obliterated. It goes without saying that only a very small amount of hydrocele was present in these cases and that no hydrocele fluid was found at all when the entire cavity was obliterated. This being the case the natural sequence is that isolation of the epididymis is difficult, hence at operation it is possible, unless great care is exercised, to cut into the layer of the tunica covering the body of the testicle. In one case where this was done, herniation of the testicle with complete loss of testicular tissue resulted.

The epididymis, in this series of cases, was involved to a variable degree. Often, upon examination, the tail appeared

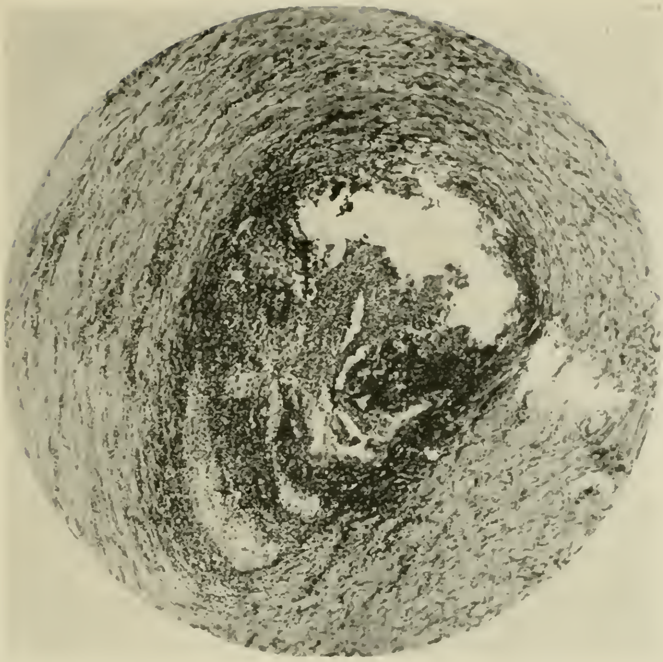

Fig. 5. Abscess Formation in Wall of Tubule with Leucocytic Infiltration of the Surrounding Tissue

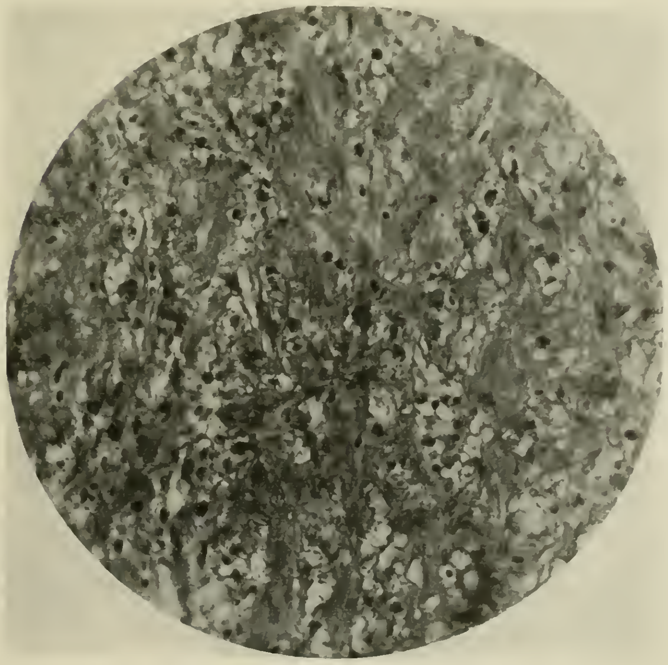

Fig. 6. Edema of Connective Tissue; also Presence of Vacuoles

to be the seat of the disease but at operation the entire epididymis was found to be more or less involved. Distinct fluctuation and evacuation of pus from the tail of the epididymis occurred in 10 cases. In several instances, although the tail was involved to a greater degree, the head and body were also more or less thickened and often the seat of marked hyperemia. The cord was thickened in 22 cases and its extensive involvement in this series may be accounted for by the fact that none of these cases was operated upon early, as operation was resorted to only after failure of the usual routine treatment and many cases were admitted to the hospital after having had epididymitis for three or four weeks. Although in some cases no free pus was found at operation, the relief of pain was just as complete as when pus was evacuated.

Only in a few cases did the fibrinous exudate extend up onto the cord. In particularly fulminating cases the vas deferens was enlarged and thickened, and edema of the entire cord occurred when, upon palpation before operation, the cord was found to be hard and greatly enlarged. At times the edema was so pronounced that the cord appeared white and waterlogged.

Chronic epididymitis

There were 11 cases of chronic epididymitis, that is, cases in which the patients had complained of pain or pain and swelling in the epididymis for periods varying from six months to sixteen years, during which period of time they had had occasional acute exacerbations of epididymitis and most of them had sought relief because of pain. Of these 11 cases, 9 were of non-gonorrheal origin. The following associated lesions of the urinary tract were noted: chronic pyelitis and cystitis (4 cases); chronic cystitis following prostatectomy (1 case); carcinoma of the prostate (1 case); chronic prostatitis and chronic seminal vesiculitis (1 case).

Two of these cases may be attributed to a venereal origin inasmuch as the patient had had gonorrheal infection complicated by acute epididymitis a number of years before, three

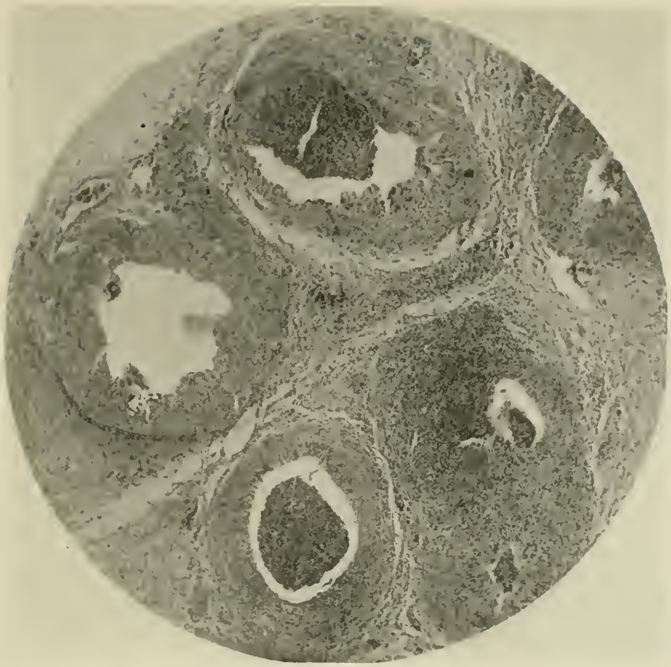

Fig. 7. Lumen of Tubule Filled with Leucocytes; Infiltration of Wall of One of the Tubules with Leucocytes; Extensive Infiltration of Intertubular Connective Tissue

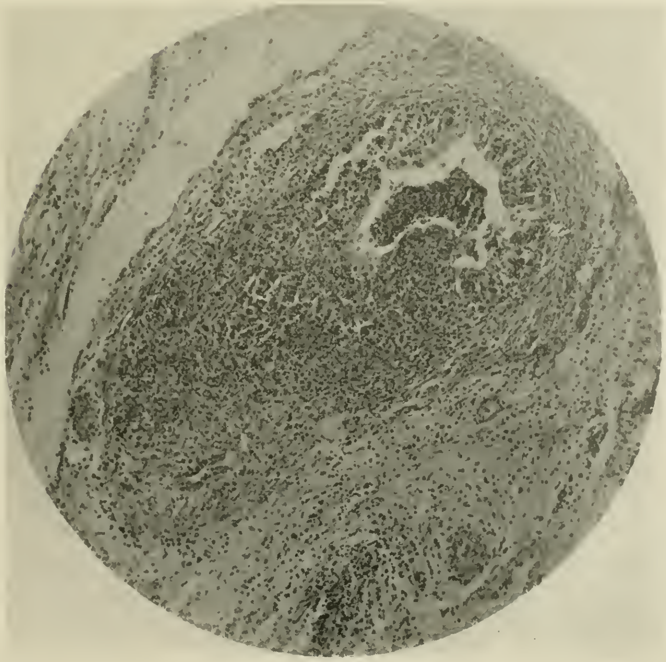

Fig. 8. Abscess in Wall of Tubule; Rupture of Abscess into Lumen of Tubule; Extension of Abscess into Surrounding Tissue

and a half years in one case and sixteen years in the other, the pain and swelling in the epididymis remaining after the acute epididymitis had subsided.

The reasons for operating on this group of patients was due to the fact that they suffered from pain in the epididymis, which was considered of more moment than the simple enlargement of the epididymis. Without exception the pain ceased after operation.

Histopathology, acute cases

Of the 26 cases, 2 were non venereal; 3 were bilateral, 1 of which was secondary to an infected tabetic bladder. There was no essential histological difference noticeable between the venereal and non-venereal cases.

In every acute case the striking histological picture was in the leucocytic invasion throughout the epididymis, involving both the interstitial tissue and the tubules. In 18 of the 29 epididymes varying degrees of proliferation of fibroblasts were found. In every case there was noted some edema of the fibrous connective-tissue and at times an excessive deposit of fibrin. Hyaline degeneration was seen in 16 cases.

In practically all the cases a growth of new capillaries and enlargement of the blood-vessels were noted, both capillaries and blood-vessels being engorged. In many sections blood had gained entrance into the tissues per diapedesis. Of special significance was the increase of the blood supply in those cases that had lasted longer than one week.

Abscesses were seen in practically every case, and, as a rule, the abscesses involved both the tubules and the intertubular tissue. The majority of the abscesses were composed of polymorphonuclear leucocytes, although 3 cases showed lymphocytic predominance and 8 cases were mixed. In several cases an abscess composed of polymorphonuclear leucocytes and lymphocytes was found, the tissues around these abscesses being invaded by a mixture of the two types of leucocytes.

The tubules showed varying degrees of involvement from a

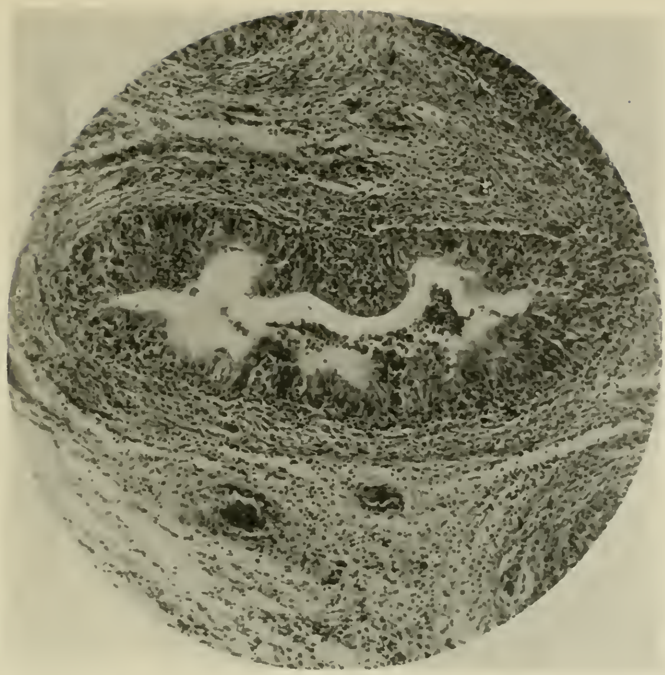

Fig. 9. Migration of Polymorphonuclear Leucocytes Through Wall of Tubule; Extensive Edema of Surrounding Tissue

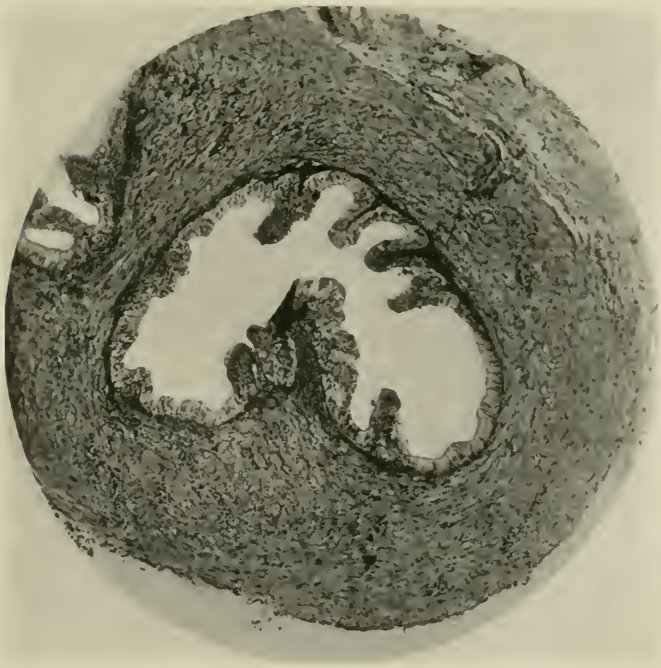

Fig. 10. Papillary Arrangement of Lining Epithelium Showing Central Connective Tissue Stalk; Dense Connective Tissue Surrounding Tubule

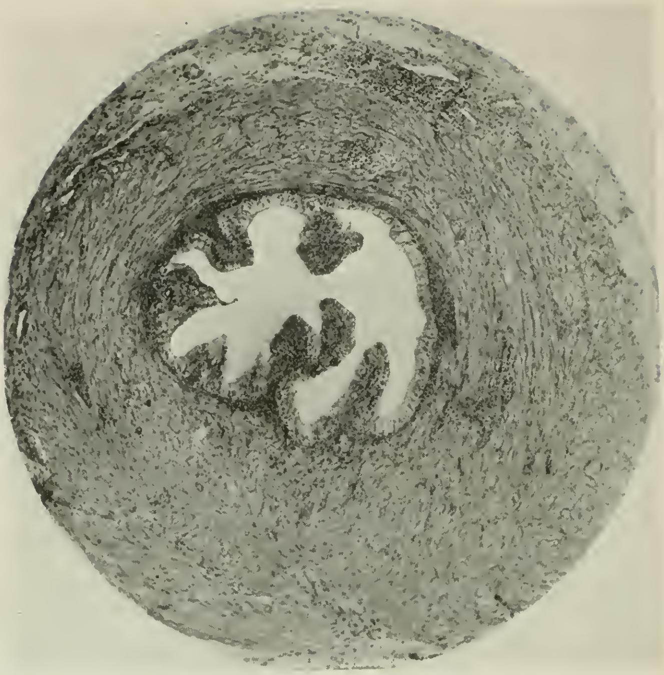

Fig. 11. Same as Figure 10

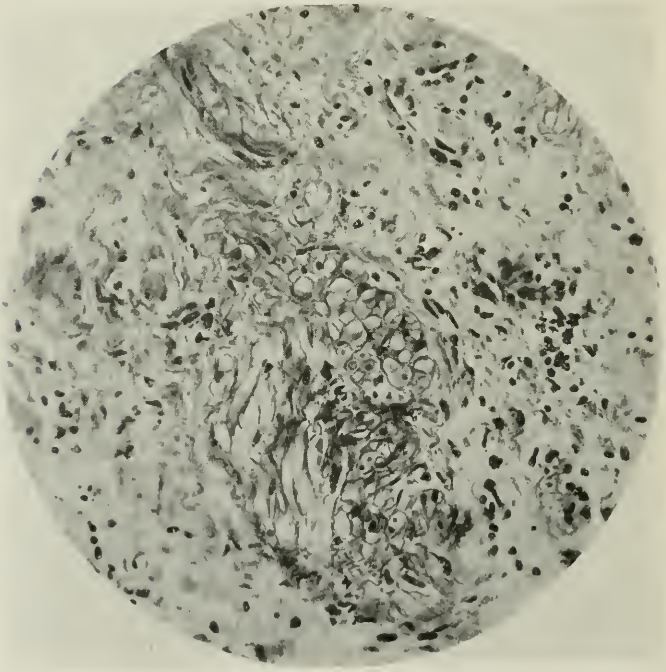

Fig. 12. Edema of Connective Tissue with Vacuole Formation

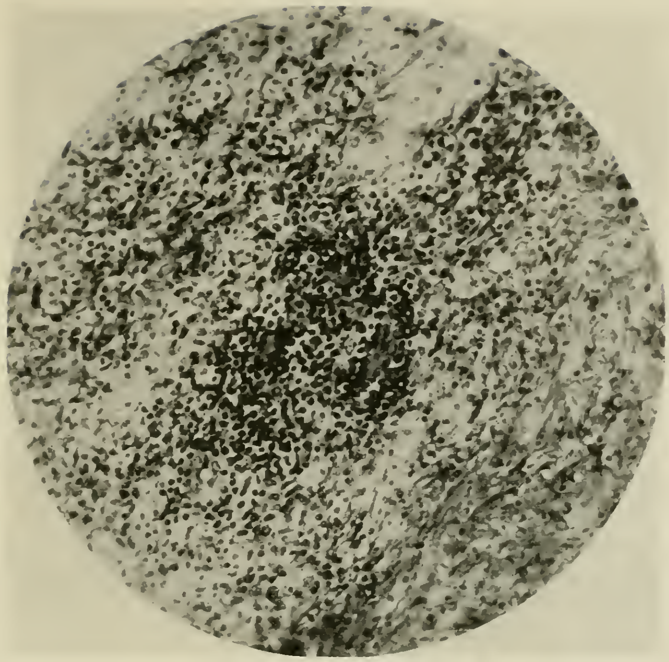

Fig. 13. Abscess Formation in Intertubular Connective Tissue

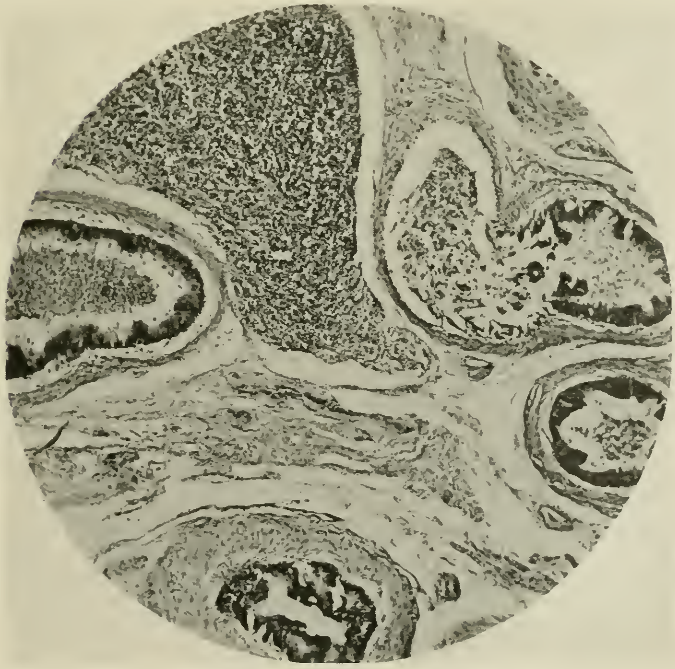

Fig. 14. Section from a Painful Nodule Showing an Intertubular Destruction of Epithelium of Upper Tubule

slight edema to complete degeneration and destruction. Only in one case were a few tubules normal, the others being involved in an abscess.

The lining epithelium indicated inflammatory changes. In every case the epithelium of some of the tubules was edematous and had degenerated, and in 27 epididymes migration of leucocytes and plasma cells through the walls of the tubules was noted.

Some tubules were closed as a result of marked edema of the walls and the lining epithelium, but the majority were closed by plugs of leucocytes and debris within the lumen. In many tubules the lumen was so packed with leucocytes that the degenerated epithelium was apparently held in place by them. In 19 cases very definite peritubular collections of leucocytes were noted, formed somewhat as a line of demarcation or resistance to the invading organisms.

In a few cases a rather striking coincidence was noted, the differential leucocyte count showing an increase in the eosinophiles of the blood. Many eosinophiles were present in the sections.

One case, probably the result of trauma one month before operation, showed a considerable number of fairly normal tubules, the lumen of which was empty and the epithelium only slightly edematous; however, there were other tubules in the sections that were involved by polymorphonuclear abscesses. This was the only difference between the histology of this epididymis and that of the other epididymes in the series.

Microscopic pathology, chronic cases

In this series there were 12 chronic cases. In every case the predominating feature of the pathology was the proliferation of fibrous connective tissue, often edematous. Some cases showed considerable degeneration depending upon the activity of the infection at the time of operation.

The blood-vessels were increased in number in 4 cases and notably scarce in 5 cases. In every case the blood-vessel walls were much thicker than normal, and only 8 of the 12 cases

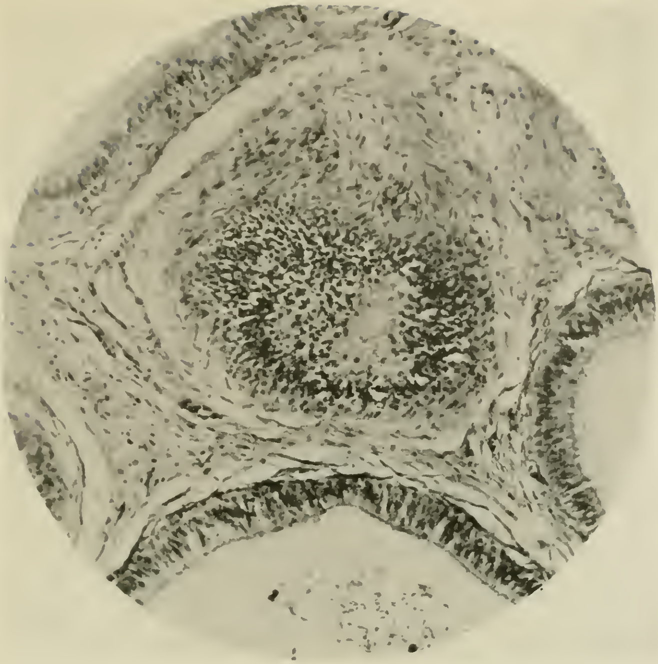

Fig. 15. Section from a Painful Nodule; Complete Destruction of Tubule with Abscess Formation

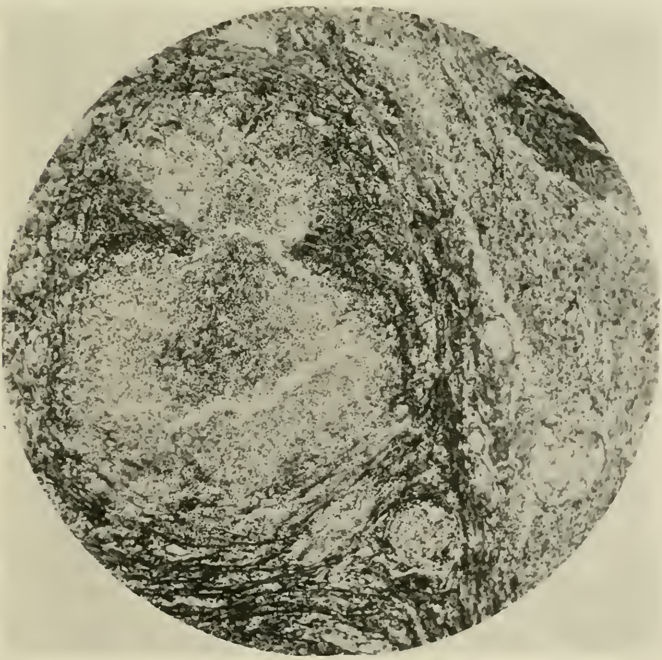

Fig. 16. Complete Destruction of Tubule Due to Abscess Formation

showed engorgement of the blood-vessels. The walls were apparently stiffened by the thickening and contraction of the surrounding fibrous tissue.

In 6 of the cases, abscesses in the intertubular tissues were found, varying greatly in size. Eight cases showed minute abscesses involving the tubular walls and epithelium, the leucocytes, as a rule, invading the lumen of the tubules. The abscesses were composed of lymphocytes in 2 cases, of polymorphonuclears in 1 case and were mixed in 6 cases, the predominating type of the leucocyte in the latter being lymphocytes.

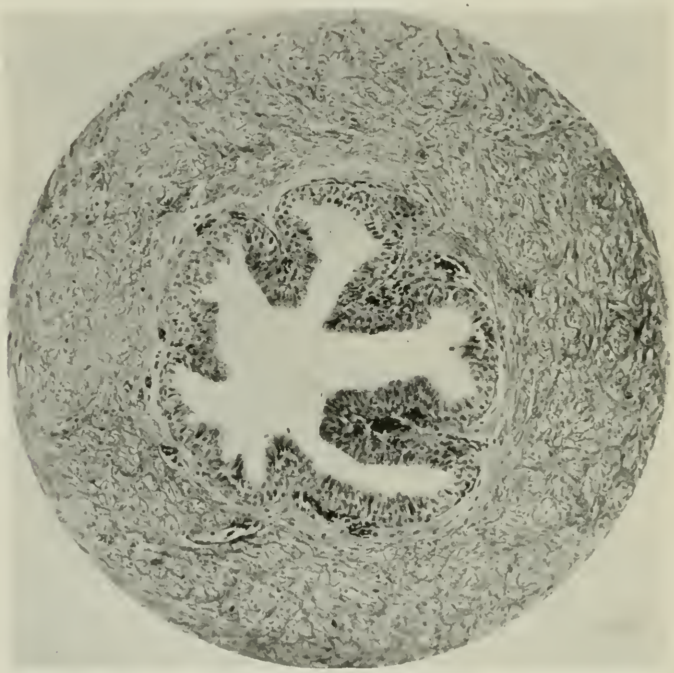

Fig. 17. Papillary Arrangement of Lining Epithelium

Only in 5 cases did the intertubular tissue show an appreciable deposit of fibrin. This tissue was generally infiltrated, in varying degrees, by lymphocytes or by polymorphonuclears, or by a mixture of both.

The tubules, as a rule, showed the effects of the chronic inflammation, either as an edema and degeneration or as a change in the epithelium, or in thickening and fibrosis of the tubular walls. The lumen was patent in some of the tubules in each section, whereas in other tubules it was closed by contraction of the sclerosed walls and of the surrounding excessive fibrous connective tissue. In every case there were some tubules that were plugged up with leucocytes and debris. Hence, in the same section, there were some tubules that were patent but seemed to be stiffened by the fibrosis of the walls; some closed by edema of the lining epithelium and walls; some by contraction of the tubular walls and surrounding fibrous connective tissue; and some plugged up with inflammatory products. Practically all the tubules showed irreparable damage resulting from the inflammation. Only in 6 cases were peritubular collections of leucocytes noted, a common occurrence in acute cases.

The effects of the recurring inflammation in some cases were evident, parts of the sections showing an inactive process which had resulted from a previous attack, while other parts showed an active chronic reparative process. The presence of the minute abscesses in the chronic cases may have accounted for the constant, persisting pain of which these patients had complained.

In several cases tubules were seen whose epithelium was of the papillomatous type, due probably to contraction of the walls, which folded the epithelium and supporting layers into papillae. In some cases the epithelium had changed from the normal ciliated cylindrical to a non-ciliated stratified columnar and squamous type. Normal epithelium was completely absent.

There was no apparent histological difference between the chronic non-venereal type and the cases in which the initial epididymitis was of gonorrheal origin and became chronic because its recurrence was due to associated diseases.

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SURGICAL PATHOLOGY OF THE SEMINAL VESICLES[1]

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One of the first to publish his observations on the inflammatory conditions in the seminal vesicles was Jordan Lloyd, of England, in 1889, who reported cases where he "drained the seminal vesicles by simple perineal incisions into the abscesses." He also stated that inflammation of the seminal vesicles was not uncommon and was analogous to inflammatory disease of the Fallopian tubes in women; that it was sometimes primary, but as a rule secondary to urethritis, in which the "ejaculatory ducts became obstructed and the vesicles hyperdistended but termination by suppuration was exceptional." He was followed by Robinson, an American, in 1892, who noticed in dissecting lower animals "the regularity of healthy appearing semen sacs which were not bound down by old or recent adhesions or scar." In teaching human anatomy he noticed the difference in man, the majority showing old inflammatory trouble with the walls bulging here and there in a sacculated condition, often obstructed and dilated, or bound down by partial or complete adhesions, requiring a long time to free the sacs from the mass of inflammatory products. He likewise drew an analogy to the Fallopian tubes by stating that gonorrhea soon makes a pyosalpinx which often ends as a hydrosalpinx; so also a pyospermatocyst may end as in a hydro-spermatocyst, or may recover, the same as with a Fallopian tube.

In 1904 Fuller inspired a new interest by his reports on vesiculotomy, calling attention to these structures through appreciation of the rôle of chronic suppuration in relation to various systemic disorders. Many urologists have since reported on drainage or vasopuncture and injection being done routinely in all cases where operative procedure was undertaken. But in studying the pathology of sections taken from different cases at operation and comparing them with the clinical manifestations before and after operation we find that simple drainage or injection by vasopuncture or by the ejaculatory ducts is not always sufficient to accomplish our purpose and may account for many of the unsatisfactory results from these measures.

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[1] Read at the meeting of the American Urological Association, Rochester. Minn., May 21, 22 and 23, 1923.

In the chronic forms of seminal vesiculitis we find from the macroscopic study of the vesicles at operation, two distinct pathological changes—first, those involving the intrinsic structures and, second, the extrinsic processes. From these two main types of pathological vesicles there may occur many variations, but in considering the operative indications we find it convenient to classify them under four definite types.

1. In the first group, where neither intrinsic nor extrinsic changes are macroscopically evident, we find large thin-walled vesicles, distended with secretion, from which the fascia of Denonvilliers and the perivesicular tissues are easily separated, and from which rectal massage produced no secretion previous to operation. This retention is due to the stenosis of the ejaculatory ducts caused by inflammatory changes. Another factor in maintaining this mild type of vesiculitis is a large swollen prostate, congested with blood and lymph and compressing the ejaculatory ducts sufficiently to prevent their vesicles from draining either spontaneously, or by stripping, and often prolonged in the preoperative treatment by too frequent and too violent massage.

2. In the second group, where only extrinsic changes are macroscopically evident we find the vesicles in the same cystic condition as in the first, but with marked extrinsic changes ranging from hyperemia and edema of the perivesicular tissues to dense thickened scar tissue encasing large distended vesicles. This fibrous thickening is continuous with the prostatic capsule and not only encases the vesicles but follows the ejaculatory

ducts through the prostate ensheathing and constricting them. In this type rectal massage never yields any vesicular secretion, though as stated above, the vesicles may be greatly distended with it.

3. The third group, where only intrinsic changes are macroscopically evident the vesicles are thickened and indurated with very little if any secreting capacity. On incising but a drop or two of secretion can be obtained, and often profuse bleeding results from the highly engorged vesicular and perivesicular tissues. In this group the vesicles are easily separated from their surrounding tissues.

4. In the fourth type, where both intrinsic and extrinsic changes are macroscopically evident, we find the most marked and final stages of seminal vesiculitis in which it varies from the intrinsic changes found in the third group to a marked atrophic relic encased in thick tough scar which may reach a quarter of an inch or more in thickness. At times it is very difficult to dissect them out or to find and identify them. The bladder, peritoneum ureters and vasa are drawn into closer relationship with the vesicles. The surrounding fibrous tissue may enclose the vesicles either entirely or partly, that is, it may be very thick and hard at the base of the prostate where it starts and thins out as it approaches the fundi of the vesicles. The vesicles themselves may present intrinsic inflammatory changes in any or all of the above types, in the same vesicle, with the more marked condition of the third group proximal to the ejaculatory ducts, and with distended lobules in the fundus which have become walled off and if not removed, must be opened and drained. We may find these extensive changes limited to one vesicle while the other one may be normal or exhibit only moderate inflammatory changes.

In considering the normal microscopic anatomy, the vas deferens, ampullae, and seminal vesicles are similar in structure, each having a mucosa supporting several layers of epithelium.

External to the mucosa is a muscularis, consisting of two layers of involuntary muscle, the inner or circular is thick, and the outer longitudinal layer somewhat thinner with a thin submucosa connecting the mucous and muscular tunics. Outside of all is the fibrous adventia which is continuous with the surrounding connective tissue and contains bloodvessels and lymphatics.

The mucosa is thrown into folds, somewhat like that of the Fallopian tube. These divide the vesicular lumen into labyrinthin spaces. Normally the folds are moderately thin and may give off secondary divisions (fig. 1).

In the cystic types of vesiculitis seen in the first two groups, the secreting folds are flattened out or shortened to a mere process, with the lumen filled with secretion more or less cellular. The columnar epithelium is flattened (fig. 2).

In the hydro-spermatocystic type, the secreting folds show fibrous thickening in places, with denuding of epithelium, and having attached by somewhat indefinite fibrils the secretion in the lumen which appears more or less cellular and vacuolated.

In other places there is round celled infiltration in the secreting folds.

The early stages of the non-cystic types show more or less thickening of the mucous folds due to round celled infiltration, with denuding of epithelium at their extremities and the formation of granulation tissue (fig. 3). The capillaries at the ends of the folds are dilated and engorged; areas of hemorrhagic exudate are occasionally seen. These thickened folds throw out buds of granulations from their free ends, which coalesce and shut off the underlying recesses (fig. 4). Fibrous thickening in the walls of the vesicle takes place and often becomes excessive. The entire thickness of the secreting folds may become infiltrated by round and plasma cells and fibroblasts.

Later these granulating ends of the mucous folds become more fibrous in character compressing and closing the underlying recesses which are filled with inflammatory exduate, secretion and cellular debris (fig. 5)..

The lumen of the vesicle becomes narrowed and filled also with inflammatory debris and more marked fibrosis of the secreting folds, which undergo greater destruction both by compression and inflammatory infiltration, many places showing leucocytic infiltration (fig. 6).

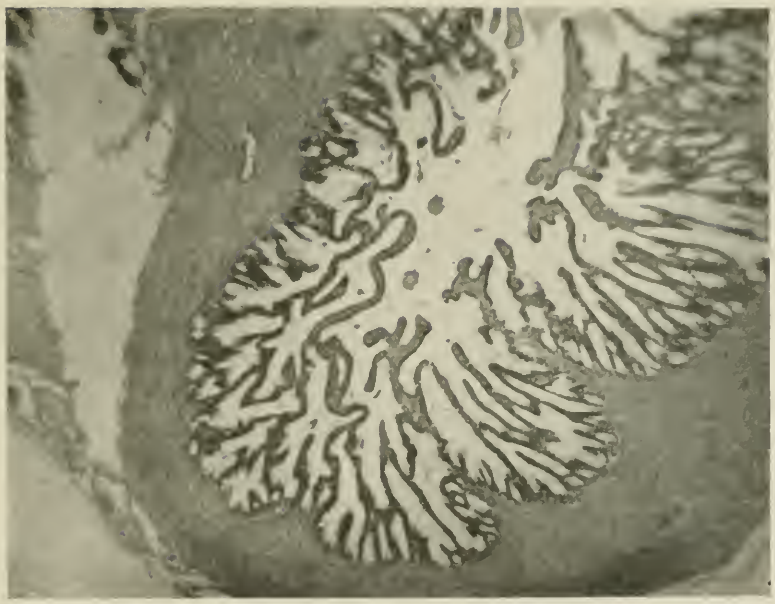

FIG. 1. TRANSVERSE SECTION OF VESICLE SHOWING COMPLICATED INFOLDINGS OF NORMAL SECRETING STRUCTURE

D. 329; Obj. A; Oc. 2 inches, Zeiss; Bel. 12 inches; T. 15; D. ½

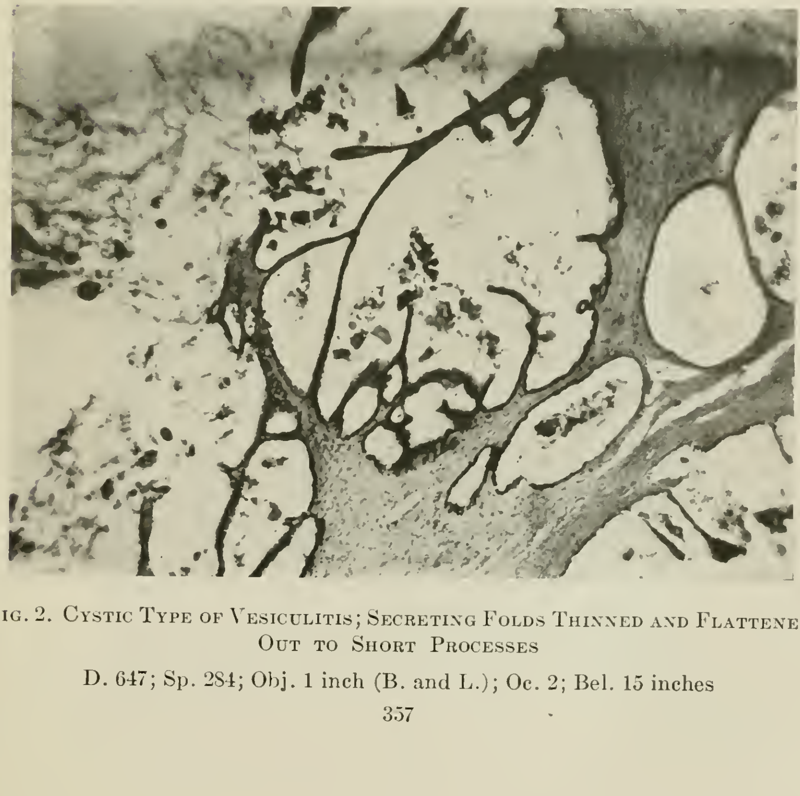

FIG. 2. CYSTIC TYPE OF VESICULITIS; SECRETING FOLDS THINNED AND FLATTENED OUT TO SHORT PROCESSES

D. 647; Sp. 284; Obj. 1 inch (B. and L.); Oc. 2; Bel. 15 inches

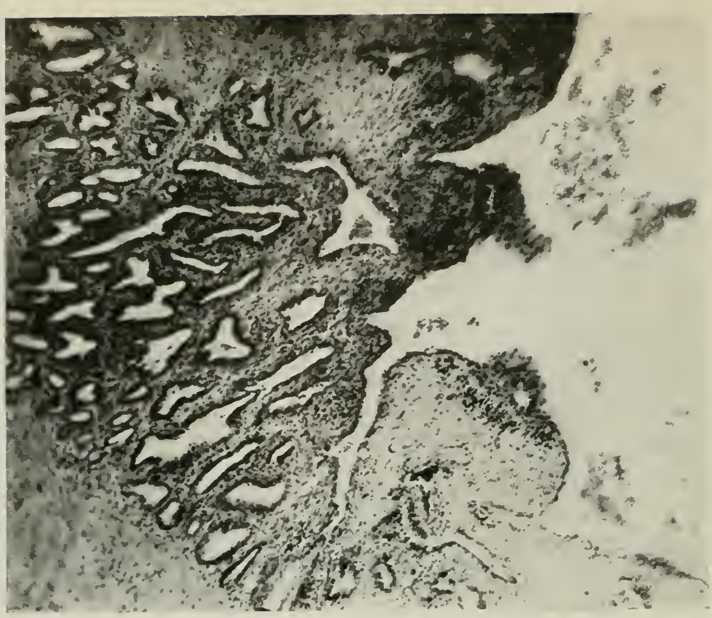

Fig. 3. Mucous Folds Thickened by Round Cell Infiltration; Extremities Denuded of Epithelium, Throwing Out Granulation Buds

Sp. 284; D. 329; Oc. 4; Obj. 1 inch (B. and L.); Bel. 15 inches

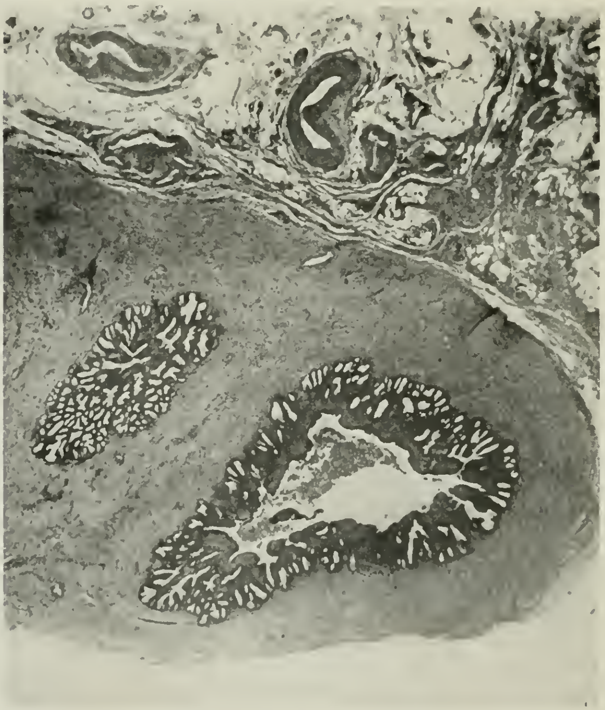

Fig. 4. Excessive Fibrous Thickening of Walls of Vesicle and Marked Coalescence of Thickened Mucous Folds; Very Low Power

Sp. 91; D. 279; No. 11; Box 33; Obj. 3 inches; Oc. 2 inches; Zeiss

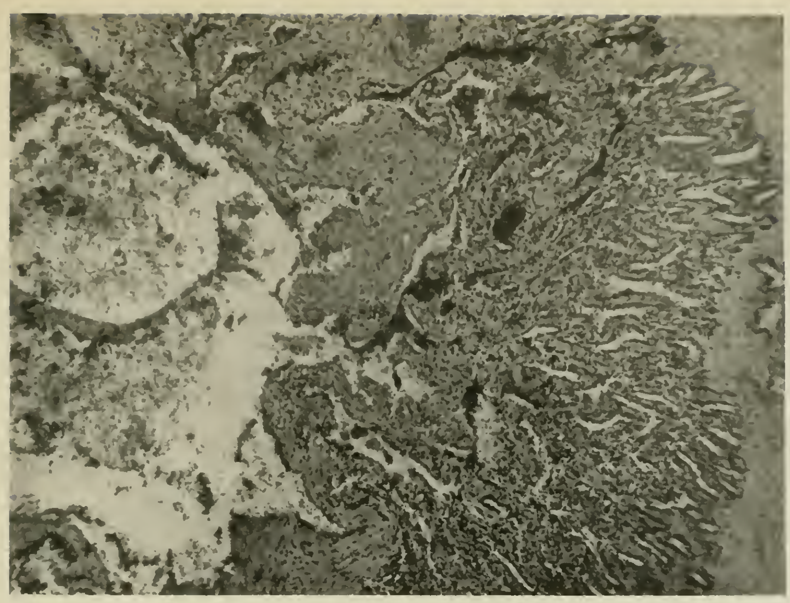

FIG. 5. FIBROSIS OF ENDS OF FOLDS WITH COALESCENCE AND DESTRUCTION OF SECRETING EPITHELIUM, LUMEN AND RECESSES FILLED WITH CELLULAR DEBRIS

D. 329; No. 4; Obj. A; Oc. 2 inches

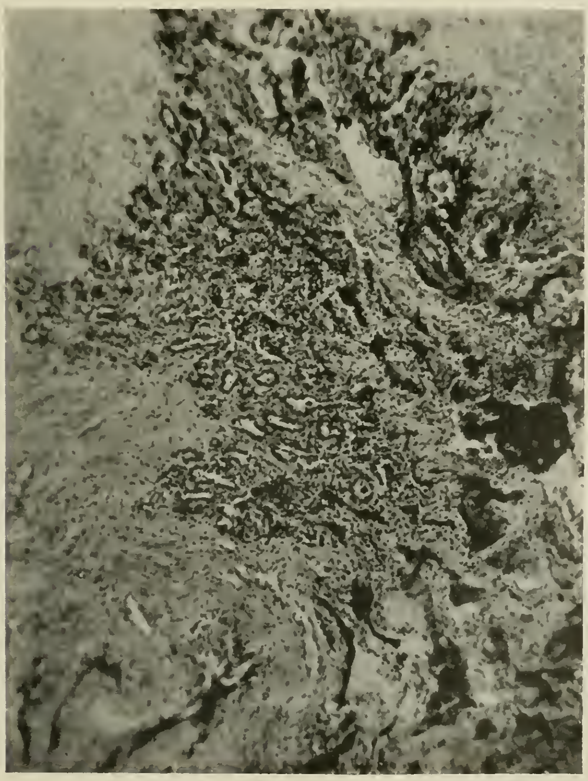

FIG. 6. ADVANCED DESTRUCTION OF SECRETING STRUCTURES AND COMPRESSION AND PLUGGING OF SPACES WITH CELLULAR DEBRIS

D. 329; Obj. A; Oc. 2 inches Zeiss; Bel. 12 inches; T. 15; D.½

Part of the lobules may be more or less normal, others dilated and containing cellular debris, while many are nearly obliterated by fibrosis and compression (fig. 7). Occasionally a secreting recess will be pinched off by thickened stroma and become cystic, lined by a layer of flattened epithelium while the rest of the lobule undergoes atrophy (fig. 8).

The walls of the vesicles often undergo marked fibromuscular hyperplasia in the advanced types and cause destruction of the glandular elements in many lobules from compression alone (fig. 9).

The areolar and adipose tissues in the perivesicular areas are often infiltrated with round cells and leucocytes intermixed (fig. 10).

In the more advanced stages of perivesiculitis marked leucocytic infiltration and small abscesses may form (fig. 11), being supplanted in time by dense fibrosis with marked cellular infiltration of the areolar connective tissue clefts (fig. 12).

Throughout the series the pathological changes are irregular in distribution and between the foci of destruction there are areas quite normal or slightly involved, while again whole lobules are destroyed. The most striking changes in the advanced cases are the extensive fibrosis and the destruction of the secreting mucous membranes.

In types 1 and 2 the operative results were uniformly good for vesiculotomy: In type 3, the results were good on excising the vesicles, and only slightly improved, if at all, on draining them. In type 4, the results of drainage were uniformly poor principally because of the impossibility of thoroughly opening up all foci of infection in both vesicular and perivesicular tissues, In all types there is from slight to complete retention of vesicular secretion and in the extreme pathological types there is more or less complete suppression and absence of secretion due to the destruction of the secreting epithelium, the thickening of the vesicular walls and the filling of the cavities with debris.

The pathological condition in each individual case should determine the selection of treatment, in which the skill and experience of the examiner play an important part. The vesicle

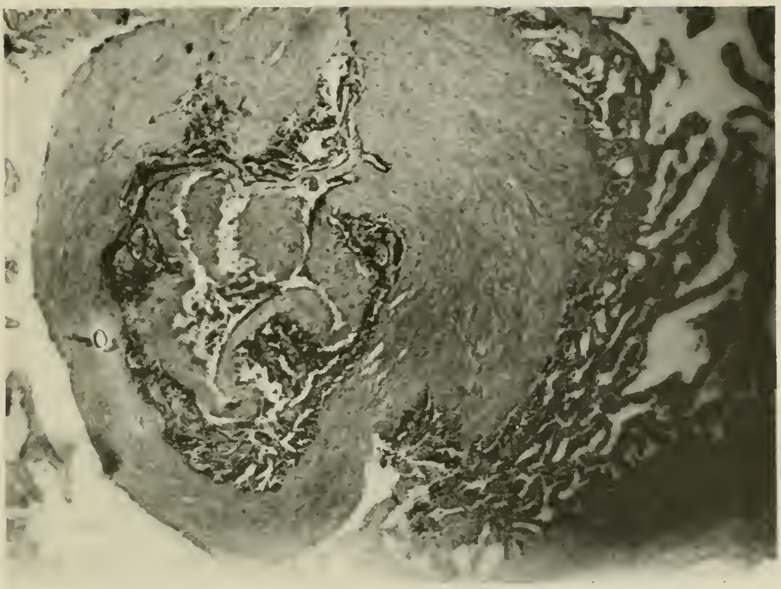

Fig. 7. Part of Lobule Fairly Normal; Also Fibrosis, Compression and Inflammatory Destruction

Sp. 284; D. 260; Oc. 4; Obj. 1 inch (B. and L.); Bel. 9½ inches

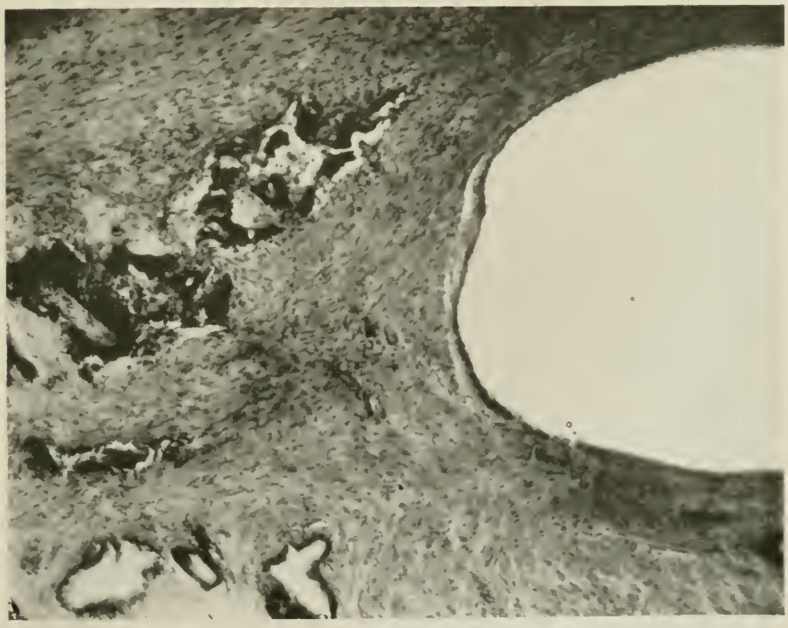

Fig. 8. Fibrosis, Atrophy, Cystic Dilatation

Sp. 284; D. 294; Oc. 4; Obj. 1 inch (B. and L.); Bel. 14½ inches

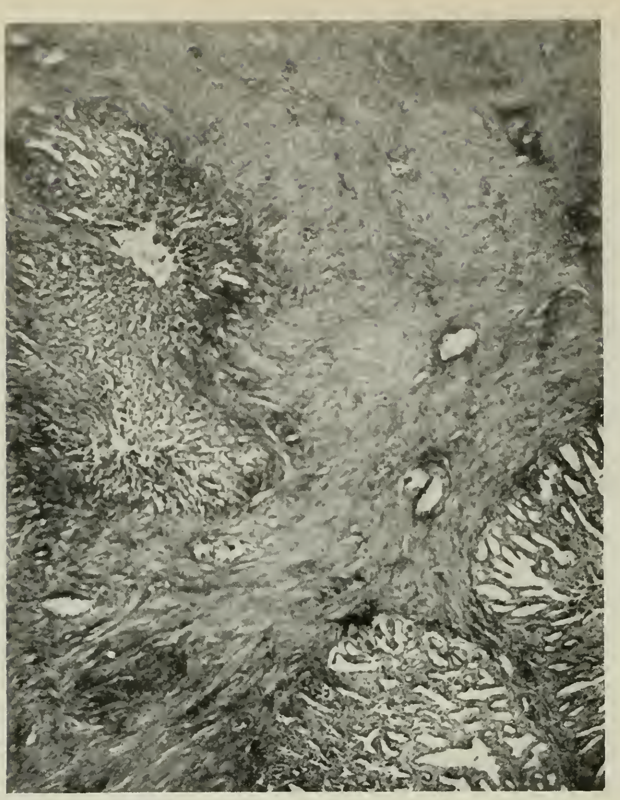

Fig. 9. Hyperplasia of the Fibromuscular Wall of Vesicle with Compression of Secreting Structures

D. 329; No. 3; Obj. A; Oc. 2 inches

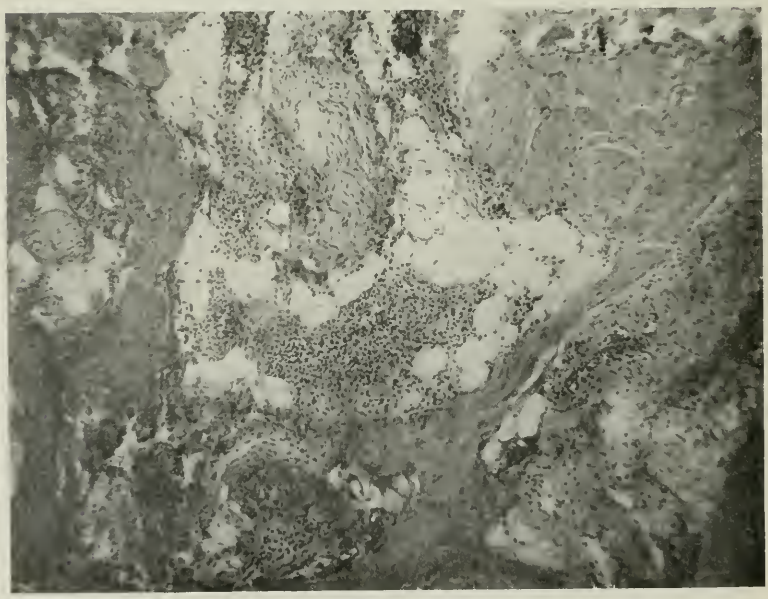

Fig. 10. Cellular Infiltration of Perivesicular Tissue at Considerable Distance from the Vesicle

Sp. 91; D. 260; No. 6; Box 33; Obj. a; Oc. 2 inches, Zeiss

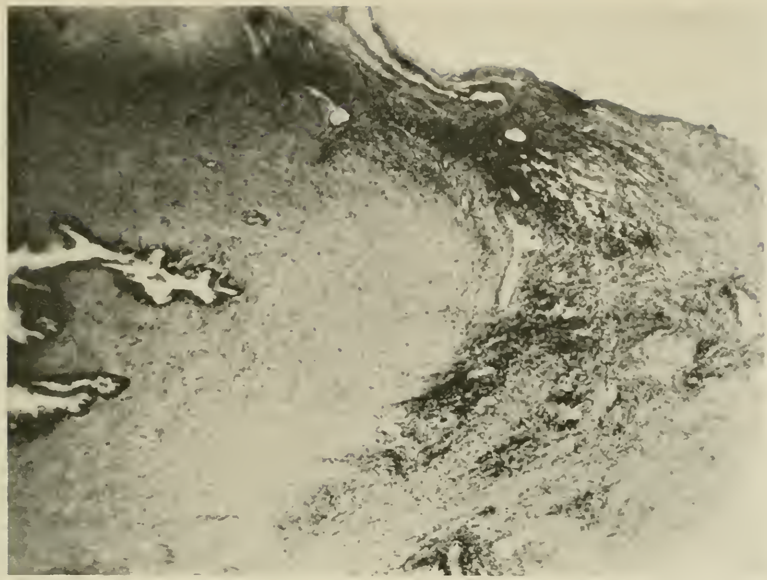

Fig. 11. Fibrosis and Atrophy; Marked Leucocytic Infiltration and Small Abscesses in Perivesiculitis

Sp. 284; D. 752; Oc. 2; Obj. 1 inch (B. and L.); Bel. 15 inches

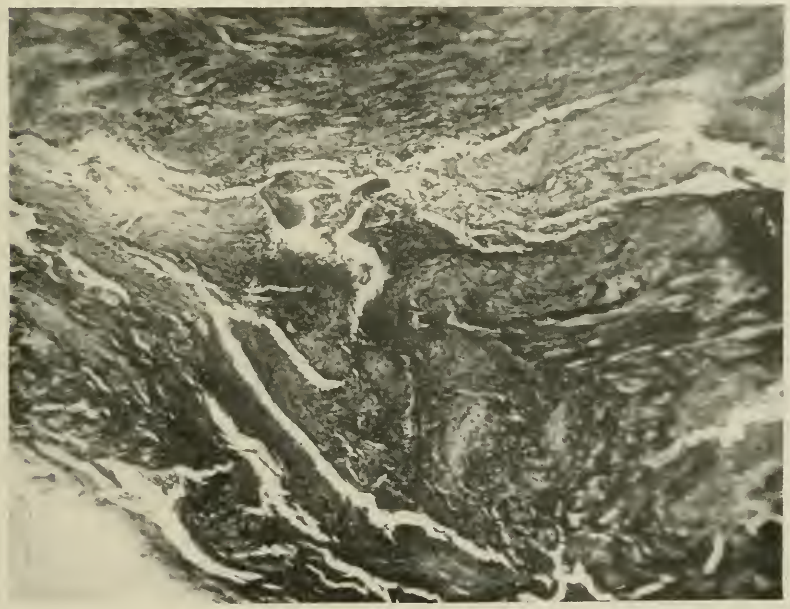

Fig. 12. Showing Dense Fibrous Tissue about Vesicle, Marked Cellular Infiltration of the Areolar Connective Tissue Clefts

D. 213; No. 2; Obj. A; Oc. 2

acts both as a reservoir, and secretes itself, as shown by it readily filling from the vas, therefore, a certain amount of distention of the vesicle is physiological in which case the contents are generally easily expressed by rectal massage, while in the true cystic types no vesicular secretion can be obtained. No spermatoza have been found in the secretions taken on puncturing the vesicles at operation in the larger percentage of our cases, but definite conclusions on the vesicles harboring spermatoza cannot be drawn because these cases were selected and operated upon as pathological. Thickening and stiffening of a vesicle as a whole or in part where no gelatinous vesicular secretion can be obtained by rectal massage indicates a pathological condition. Definite tenderness in a vesicle or in perivesicular structures, distinguished from the normal sensitiveness of the region, and not relieved by emptying, may indicate a more acute focus. Examination of the vesicular contents does not always give us reliable information for operative indications, because a patient may have large patent ejaculatory ducts, allowing a previous vesiculitis to drain and heal and massaging may produce each time small shrunken vesicular casts, but a marked perivesiculitis will persist and keep up systemic disorders. If the perivesiculitis has not reached the stage of fibrosis and the vesicles can be stripped of their contents they will almost without exception respond to the non-operative measures of treatment if properly given.

Since Belfield first gave us the idea of X-raying the seminal vesicles, various techniques have been developed by others to further aid in the diagnosis of pathological conditions. However as in ureteral catheterization and pyelography, injection of the vas and vesicles by vasotomy, or dilatation of the ejaculatory ducts are not without their dangers of adhesions from infections, trauma, hemorrhage, and epididymitis. These dangers are undoubtedly minimized if the proper technique is followed upon carefully selected cases, and not only beneficial therapeutic results be obtained, but in many cases may determine the applicability of more radical procedures as vesiculotomy or vesiculectomy.

Our results from vasotomy and injecting, also from dilating the ejaculatory ducts were attended by too high a percentage of epididymitis to be satisfactory to us or to draw conclusions as to their real merits. In a series of 6 vesiculectomies, filiforms were passed through the vesicular stumps and the ejaculatory ducts to the urethra for the purpose of dilating the ducts. Three were followed by epididymitis, so this practice was discontinued.

Often men with gonorrheal rheumatism have stated that their rheumatism was relieved for a day or two following intercourse. These cases most likely can be placed in the first two groups, where the destructive changes are in the milder state, and the vesicles are still sufficiently elastic to be able to throw out their contents through the involuntary musculature in the vesicular walls during ejaculation. But men with their vesicles in the more pronounced stages have, as a rule, had their sexual capacity greatly reduced and even become impotent. In no case in our series has any man had his sexual capacity rendered less active than it was before, either vesiculotomy or vesiculectomy, and in many cases where a patient had been impotent previous to operation he recovered his sexual capacity in a few weeks or in some cases, after several months. But we have no data in our series of vesiculotomies and vesiculectomies as to the effect on sterility.

CONCLUSIONS

1. A broader knowledge of the symptoms and signs of the various conditions of the histology and pathology of the seminal vesicles and perivesicular tissues will better guide us in the treatment of vesiculitis.

2. Vasotomy and injection, and dilatation of the ejaculatory ducts undoubtedly offer an important aid in diagnosis and treatment upon patients properly selected as to their condition at the time and the technique used.

3. Owing to the impossibility of incising and draining all the infected diverticula or recesses of a seminal vesiculitis, in patients not amenable to non-operative measures, it is better to do a vesiculectomy in preference to a vesiculotomy.

CONCENTRATING THE CELLS AND BACTERIA IN PROSTATIC SECRETION[1]

H. W. E. WALTHER

New Orleans, Louisiana

Received for publication June 25, 1923

The frequency with which prostatitis confronts the urologist in clinical practice and the unsatisfactory results commonly experienced in studying, microscopically, the expressed secretion of this gland, should assure any advance in technique of ready acceptance.

Recently a method has been described by Foster M. Johns for the concentration of cells and bacteria in prostatic secretion which is extremely simple of application and most gratifying in results. The method can be applied equally well to the secretion from the seminal vesicles.

In brief, Johns suggests centrifuging the prostatic secretion in miniature containers made of $\frac{1}{4}$-inch glass tubing, then removing the supernatant fluid with a capillary pipet, and utilizing the sediment for smears which are fixed and stained in the usual manner.

The advantages to be derived from employing this procedure are obvious. For determining accurately the degree of inflammation present in the prostate as well as for recognizing the causative microörganism it has proved superior to any other known method. Particularly has its value been demonstrated in those cases of males who, contemplating matrimony, desire to know whether or no they still harbor gonococci. By this method the writer has repeatedly demonstrated myriad colonies of Gram-negative diplococci in the prostatic secretion of patients who had been pronounced cured by physicians using a less exact method of microscopic diagnosis. The superiority of concentrated, freshly stained material over a cultural study is

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[1] Read at the meeting of the American Urological Association, Rochester, Minnesota, May 21, 22 and 23, 1923.

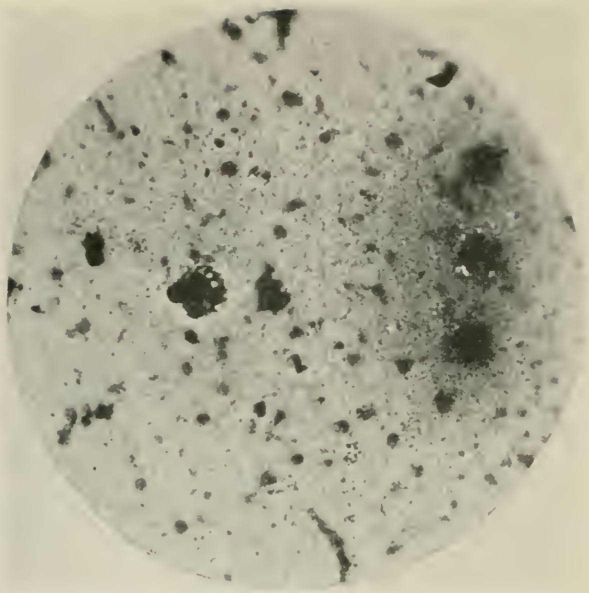

Fig. 1. Photomicrograph (High Power) of Prostatic Secretion before Being Concentrated, Showing a Single Pus Cell, Three Small Granular Cells and No Bacteria

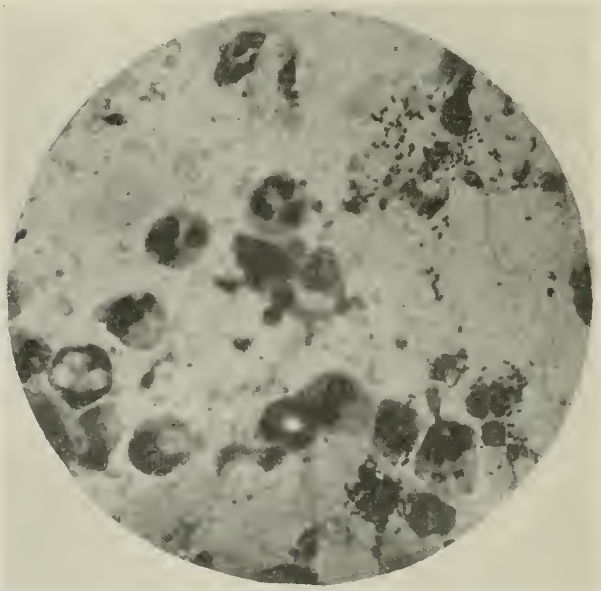

Fig. 2. Photomicrograph (High Power) of the Same Prostatic Secretion Shown in Figure 1 after Concentration, Showing Many Pus Cells and Numerous Pneumococci

irrefutable. For the contaminations so often encountered in prostatic secretion cultures make them of doubtful value.

Lately the writer has modified the technique of Johns to the extent that ordinary urine centrifugal tubes have been substituted for the smaller containers he advises. This obviates the addition to our laboratory equipment of any extra paraphernalia. And in no way does it detract from the procedure. At massage one usually obtains from 1 to 2 cc. of secretion, and the sediment of this amount, centrifugalized for one minute in the tube, can easily be extracted with a platinum loop.

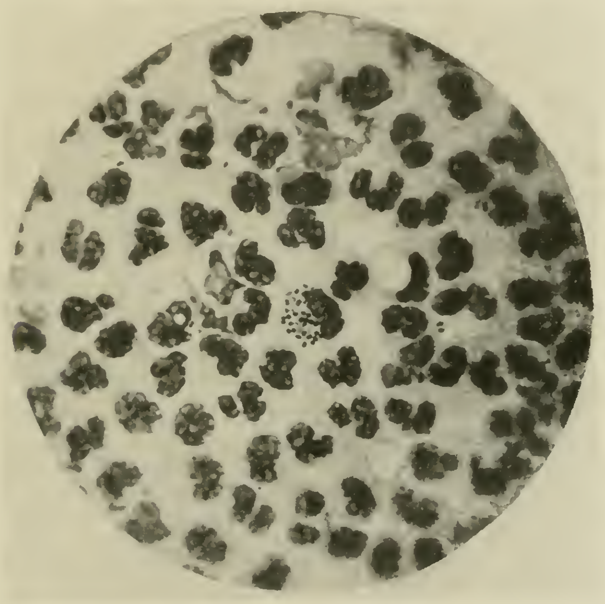

Fig. 3. Photomicrograph (High Power) of Prostatic Secretion after Concentration, Showing an Excess of Pus and Intracellular Diplococci of Neisser

I wish to acknowledge my indebtedness to Dr. Johns for having made the photomicrographs for me, illustrated herewith.

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Johns, F. M.: A method for the concentration of cells and bacteria in prostatic secretion. Jour. Amer. Med. Assoc., February 17, 1923, lxxx, 463.

DISCUSSION

Dr. Victor D. Lespinasse (Chicago): I would like to speak on Dr. Kretschmer's paper on the pathology of the epididymis. A phase of the pathology that I see a great deal of is the late pathology after the epididymitis is from two to fifteen years old. We find as we operate on these men to relieve their sterility and reestablish the lumen of the tubule of the epididymis that many times the cavity of the tunica vaginalis is completely destroyed. Very seldom, however, is there a complete sticking together of the two layers, but often with little hydrocele-like cysts scattered throughout. That is an extreme type of case. Then we have those less severe types where the fossa between the epididymis and tubule is closed completely, and some cases where bands of adhesion running across from epididymis to testis are more or less numerous. The lower half of the epididymis is the portion that receives the greatest infection. and that to my mind proves that this infection comes through the vas and not through the lymphatics or any other way. For that reason if you try to inject the epididymis through the vas you can only inject the first compartment. Then your swelling epididymis tube binds the lumen and your fluid will not go on up. Your vas comes in here at the lower end of the epididymis and at the other end you have the tubules into the testicle. As your vas comes into the first compartment the fluid comes into the tubules and distends them so that the pressure interferes with the outlet into the testicle, and it is a great task to get the injection into more than one, rarely two, compartments. That fact seems to me to prove the point that epididymitis is vas-borne and not lymphatic-borne.

Another point that has prevented our knowing so much about acute cases is the fact that when you take a specimen for examination you cut off the tubules and that many times deters some of us from taking these specimens because if we do we are certain to render the man sterile on that side.

Another point in the late pathology is that the epididymis has a secretion. The epididymis is not a simple conducting tubule, but has a secretion which is a thin, watery glycerine-like substance. You will see this oftentimes where you have the epididymis constricted above and below. You will find the portion above the stricture is distended and there are sperm in its lumen. In this segment where the tubule is cut off above from sperm and below from outlet, you will find the dilated tubule filled with a sweet, glycerine-like substance. If the obstruction is farther down then you find your vas and epididymis filled with a substance that looks like thick cream. Just what that substance is or the manner of its production is one of the things that is not quite clear. This substance looks like fat, but gives none of the chemical reactions for fat.

Dr. B. C. Corbus (Chicago): In discussing the pathology of epididymitis as presented by Dr. Kretschmer, we all recognize that we can have degrees of inflammation of tissue. It seems to me the pathology depends upon the type of infection we are dealing with. We have recognized infections of the epididymis as being due to the gonococcus, the tubercle bacillus, and occasionally the Spirochaeta pallida. During the last five years we have come to know and recognize infections of the epididymis that are entirely bloodborne, and in addition we have had infections following instrumentation, where the infection itself extends by continuity of tissue. In our practice in the last eighteen months we have had 17 cases of what we call non-specific infection of the epididymis. The sources were from instrumentation, respiratory system following influenza, antrum, teeth, tonsils, furuncles, and the bowel. The germs we have encountered are the colon bacillus, staphylococcus, streptococcus, and the bacillus of Friedlander. In these cases we have had but 5 abscesses; 4 were due to the colon bacillus and 1 to the streptococcus.

Dr. Abr. L. Wolbarst (New York City): Many of these cases of chronic epididymitis are diagnosed as neuraliga of the testes. I am not sure there is such a condition as testicular neuralgia. We see these cases frequently and they are at times very painful and annoying. They are commonly observed in the so-called "sexual neurasthenics." If you examine the epididymis carefully you often will find one or more small or large retention cysts; sometimes they are as large as a cherry and even larger, usually much smaller. If these cysts are punctured, or better still, excised, in the majority of cases the so-called "neuralgia" passes off, and the patient feels much better if not entirely cured. In my experience these cysts do not recur after removal.

The thick, creamy substance that Dr. Lespinasse mentioned is perhaps the greatest obstacle to the successful termination of Belfield's operation. There is no way that I know of to determine its presence except on the operating table. If you insert a fine, firm filiform, or heavy catgut, into the vas near its junction with the epididymis, it will be obstructed in its passage after it has gone up 3 or 4 inches by this cheesy stuff; if the vas is unobstructed, the filiform or catgut will ascend the vas for a distance of 10 or 12 inches easily and without pain to the patient. In these obstructed vasa any attempt to force a passage by means of fluid injection will fail. The material is so firmly embedded in the vas that nothing seems able to dislodge it.

Dr. CHARLES M. McKENNA (Chicago): I was greatly interested in Dr. Walther's paper. I think he deserves a great deal of credit for it. I believe too little attention is paid to the bacteriological findings of the content from the prostate and seminal vesicles. In my opinion a great many cases are treated for a long time with very little knowledge of the pathology and bacteriology of the vesicles and prostate. I should like to confirm this statement by making a preliminary report of a case that I think will be of some interest to all urologists. (Lantern slide demonstration.)

The patient entered St. Joseph's Hospital in March, 1923, with the following history: A man twenty-eight years of age who suffered a gonorrheal infection five years ago. He later on developed a posterior urethritis and as a sequal, a double epididymitis, vesiculitis and chronic prostatitis. He had received treatment for all his genito-urinary conditions, and very good treatment. While in the hospital at that time he had a double vasotomy performed for the vesiculitis. It might be important to state here that his chief complaint was pain in the perineal region. In his history he said the pain was not relieved and as a result he travelled from one urologist to another.

Dr. Lawrence Hines, to whom I am indebted for the patient, was the one who suggested that we examine his seminal vesicle content and prostate content for amoeba. On massage of the vesicles and prostate we were able to express the ordinary amount of content, and on the first slide we could see a number of round bodies that resembled the amoeba, but inasmuch as they did not move, we were not absolutely sure. On the second examination we had the content placed on a warm slide and it was then that we were able to see the movement which was truly characteristic of the amoeba. At the next sitting the content was placed in a warm salt solution and kept in the incubator, where further study was made, and there was no question as to the certainty of the etiology. All slides contained a few spermatozoa, which proved that the amoeba either came from the prostate or vesicle. That point will be determined at a later date.

I might say that while Dr. Lawrence Hines passed on them as amoebae, he also had Dr. L. Hektoen, pathologist at Rush Medical College, and Dr. A. S. Warthin, bacteriologist and pathologist at the University of Michigan, both of whom confirmed the findings of Dr. Hines. A cystoscopic and urethroscopic examination was made to ascertain whether there was an opening between the bladder and bowel. This was found to be negative. A double uretheral catheterization was done and the urine found negative. We were only able to locate the amoeba in the content of the vesicles and prostate. That is to say, we could find the amoeba on the slide with living spermatozoa, which is evident on the slide in picture.

While this is a preliminary report of the case, and enough time has not elapsed to make a full report as to treatment, I will say that with massage and injections of nitrate of silver he seemed to get some little relief and the number of amoebae were less on the slide after treatment. I might mention that on early examination the patient showed as many as 8 to 10 in the field and it was by this method that we were able to tell whether or not any improvement took place.

Dr. Goldsmith of Chicago, who has done a great deal of work with amoebae, suggested that we use tea made from a shrub grown in Texas and Mexico, which is known as C-amorgossa. He stated that this was specific for amoebae in the bowel, and up until this writing I had given three injections which did seem to give the patient some relief from pain. He was at least able to go to work. Of course there are a great many drugs that can be used, such as emetin, quinine, etc.

In looking over the literature this seems to be the first case reported of amoebae in the genitourinary tract, although Sydenham reports complications of epididymitis with amoebae in the lower bowel. He says nothing about amoebae in the genitourinary tract.

In conclusion, I wish to say that this case, while apparently a rare one, only serves to show how necessary it is to make a complete microscopic examination of all cases suffering with infection in the posterior genito-urinary tract, the vesicles, and prostate gland. You will remember that this patient suffered a Neisserian infection some five years ago and was treated for same, and had it not been for Dr. Hines' suggestion to look for the amoeba, inasmuch as the patient had suffered from amoebic dysentery, I am quite sure that the case would have been overlooked. It is to Dr. Hines that I wish to give the credit of being able to report this case. A later report in detail will be given as results develop.

Dr. H. L. Kretschmer (Chicago): The gross pathology in the chronic cases in this series corresponded very well with the findings mentioned by Dr. Lespinasse.

The point brought out by Dr. Corbus regarding the fact that some of these cases are blood-borne due to infection from teeth and tonsils, agrees with some of the findings in this series. I believe some of them were hematogenous. It did not seem to make any difference in the histologic picture in either the acute or chronic cases, what type of organism produced the pathology—the microscopic picture was the same, i.e., the same in all the acute cases, whether of venereal or non-venereal origin.

Dr. Wolbarst's point about neuralgia of the testicle is good. I do not believe there is such a condition as neuralgia of the testicle. I mentioned one patient who had been treated off and on for sixteen years for neuralgia, but on removing the epididymis we found evidence of organic disease, both gross and microscopic, showing that the real lesion was in the epididymis. I think patients having pain in the epididymis have pathology and should be treated accordingly.

THE CAUSATIVE ORGANISMS AND THE EFFECT OF AUTOGENOUS VACCINES ON CASES OF CHRONIC PROSTATITIS

L. P. PLAYER, R. K. LEE-BROWN AND C. P. MATHÉ

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INTRODUCTION

Certain cases of chronic prostatitis occur in the practice of urology which are extremely resistant to all ordinary forms of treatment. The object of this investigation was to obtain culture specimens of prostatic secretion under sterile precaution, in order to determine the presence or absence of causative organisms and, if such were found, to observe the effect of autogenous vaccines on the course of the prostatitis.

Vaccines, both autogenous and stock, in great variety have been used by many investigators, and from results published one cannot help but notice how widely opinions differ: Bumpus (1) injected colon vaccine without diminishing incidence of infection. Hymen (2) reports that vaccine cannot be relied upon for a given result in genito-urinary infections. In cases of chronic prostatitis, Wesserschmidt and Walther (3) state that the types of bacteria in the secretions are numerous and varied. Gonococci are not usually present in postgonorrheal conditions. Autogenous vaccines containing all bacteria exert a favorable influence on the disease process without further therapeutic measures. According to Laird (4), cultures of prostatic secretion, killed by dry heat, suspensions made and injected, kept the infection if primary in the anterior urethra and cured posturethral infections. Lees (5) employed detoxicated autogenous vaccines, which caused the disease to run a milder course, with no complications. The prostate became normal in sixty-three days and there was less liability to relapse. Townsend's (6) results are: Gonococcic vaccine in acute gonorrhea is of negative value; in complicated cases it is of value as adjuvant to standardized treatment. Ivens (7) administered antigen serum subcutaneously and intraperitoneally with remarkably good results. Corbett and Osmond (8) in cases injected with detoxicated vaccine observed that treatment period was shortened ten days, that there were less complications, but more relapses. Pineo and Baillie (9) used polyvalent vaccine, and concluded that nothing was gained and harm followed in acute cases. Chronic cases however were benefited. Amalie Rolden (10) reports very good results in acute metritis and adnexitis of many years standing under antigonococcal vaccine therapy. A. Nanta (11): Patients all cured when treated every one or two days with autogenous antigonococcic vaccine, after the acute discharge had ceased. Treatment should be reserved for a small number of selected cases. W. Osswald (12) gave autogenous vaccines intravenously every one or two days. Their use is indicated not only when complications are already present, but as a prophylactic measure against complications in acute gonococcus urethritis, and considers them efficacious as a cure and to prevent complications. E. Frank (13) found gonococcus in 179 cases out of 210. Twenty contained other organisms and 11 had an aseptic secretion in cases of varying degrees of prostatitis.

In analyzing the opinions of the group of investigators quoted above, we conclude that nine consider vaccines efficacious, two consider vaccines useless, and one assumes a neutral attitude.

The cultural findings of E. Frank (13) do not coincide with our results; this may be due to the fact that he included quite recent cases, whereas we considered well established, resistant chronic prostatitis.

At the outset of this investigation a method of obtaining prostatic secretion without contamination had to be devised, so that the organisms, if obtained, would be those originally present in the secretion and not picked up during the passage of an instrument along the contaminated anterior urethra. Such methods as cleansing the external genitalia, voiding or irrigating the urethra with mild antiseptics, followed by the insertion of an endoscope, and this instrument in place, massaging the prostate and collecting specimens, did not, we think, completely eliminate the possibility of contamination.

In order to overcome this, the following instruments were utilized (15):

A. Metal obturator tube
B. Metal endoscope tube
C. Metal collar
D. Aspirator
E. Screw clamp
F. Self-retaining forcep
G. Fine texture rubber cot, punctured at tip

The closed end of finger cot *G* is passed through endoscope tube B, from the distal to proximal end. The open end of finger cot is everted over the distal end of endoscope, and the metal collar holds it. The self-retaining forcep *F* is passed through endoscope and grasps finger cot. The screw clamp is passed through obturator tube *A* and clamped to end of finger cot held by self-retaining forcep, the latter is removed. The obturator tube is passed through endoscope, eight twists in one direction are made with clamp holding finger cot and the endoscope with its contents is inserted through meatus for the whole length of the endoscope. The twists made by clamp are released, and the cot is everted along the urethra by means of obturator and clamp down to the prostatic urethra. The seminal vesicles are stripped, prostate massaged per rectum, and the secretion aspirated with instrument *D* and planted on the different media.

TECHNIQUE OF COLLECTION

The patient is placed in the usual lithotomy position and is prepared as for any sterile cystoscopic examination. All instruments and finger cots just prior to operation are sterilized by boiling, the latter being then dried and covered with sterile talcum. Sterile test tubes and culture media must be at hand.

During the course of this investigation special interest was taken in an endeavor to demonstrate the presence of gonococcus in cases of long standing prostatitis. For this purpose, in addi-

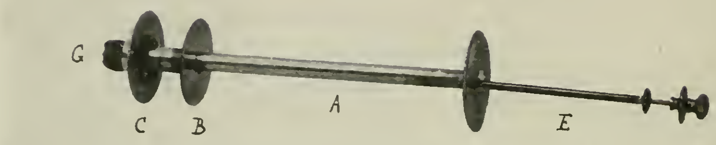

Fig. 1

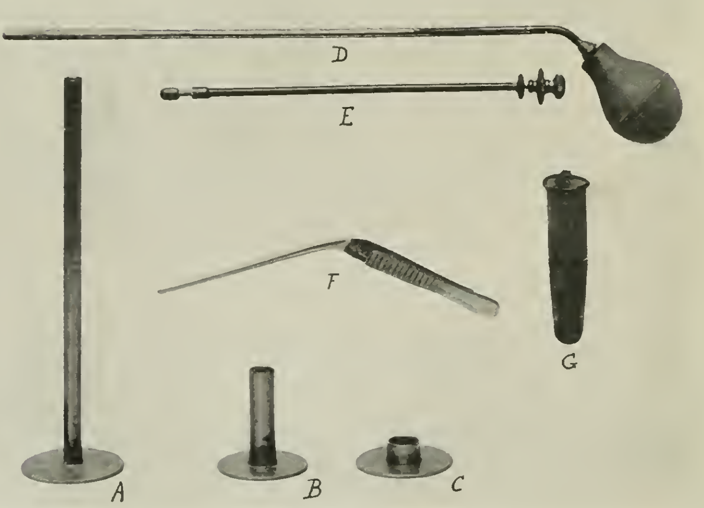

Fig. 2

tion to the ordinary procedure, a special media and technique were used (Swartz, Shohl and Davis (14)). Over 100 cases were selected and examined; these were subject to a pronounced prostatitis but showed no evidence of either bladder or kidney involvement. The following table sets forth the culture results obtained for the series of cases examined:

Sterile	57
B. coli	24
Staphylococcus albus	2
Diphtheroids	5
Extracellular diplococcus (Gram positive)	2
Staphylococcus B. coli	5
Streptococcus hemolyticus	2
Non-hemolytic streptococcus	1
Streptococcus hemolyticus B. coli	13
Staphylococcus albus Non-hemolytic streptococcus	4
B. coli B. proteus	1
Mic. catarrhalis	2
	118

Considering the number of sterile cultures that were obtained, it can be assumed that the technique employed reduced the possibility of contamination to a minimum.

The fact that the urethra had not previously been irrigated with any antiseptic eliminates the possibility of these "sterile" cultures being due to the action of any antiseptic remaining in the urethra after irrigation.

PREPARATION OF VACCINES

Autogenous vaccines were made from the cultured organisms in the usual manner, having an initial strength of 500,000,000 to 1 cc. These vaccines were administered by subcutaneous injection, the dosage being governed both by the local and focal reactions.

Injections were given on alternate days, the dosage being increased up to the point of moderate reaction. Doses producing a marked reaction were not given.

The effect of this treatment we will set forth under two headings:

1. Effect on the pus content
2. Effect on the existent organisms

1. The effect on the pus contents in our hands was in the majority of cases decidedly disappointing, as it was not appreciably diminished. We feel we cannot conscientiously state that any marked permanent benefit was observed which could be directly traced to the vaccine, as cases showing improvement did not show any better result than those treated by ordinary routine methods.

2. The effect on existent organisms was practically nil, as in almost every re-examination the same organisms were cultured out that were found originally.

In some cases a temporary marked improvement took place, this however did not persist, as upon later investigation they were found to have reverted to their former unhappy state.

The failure of vaccine to affect the course of an established chronic prostatitis is not surprising when the actual histological structure of the gland under these condition is taken into consideration.

Figure 3 is a section of human prostate exhibiting microscopic appearance of chronic prostatitis. Under these conditions is seen a cellular infiltration of the ducts and periglandular areas together with an increased connective tissue growth. The point of interest however is the purulent exudate, in which are to be found the organisms causing the prostatitis. Figure 4 is a direct oil immersion photograph of the exudate seen in the ducts of figure 3, showing colonies of organisms scattered throughout the entire field.

The following is the pathological report on this case:

> Gram stain shows many Gram-positive diplococci and many Gram-negative short rods resembling colon bacilli. Some glands are dilated forming small cysts. The adenomatous areas show glands closely arranged, but no change of note in the epithelium. There is fibrosis and hyaline changes in smooth muscle. There is no evidence of malignancy.

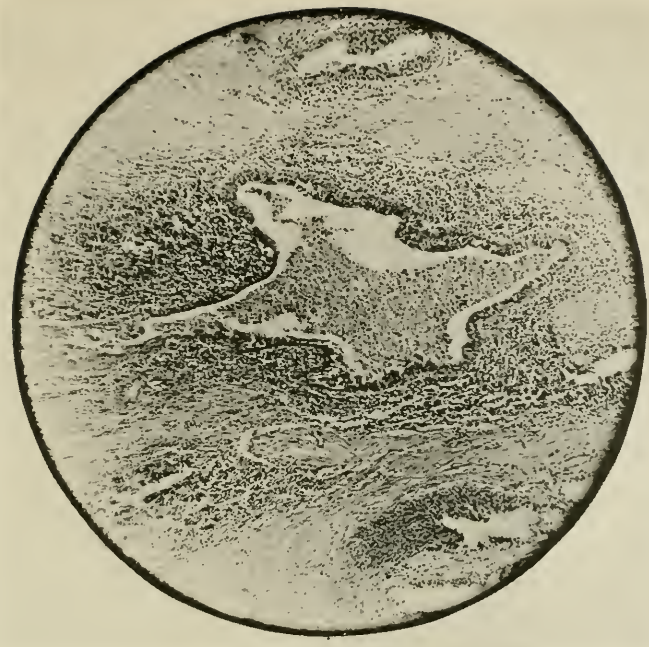

FIG. 3

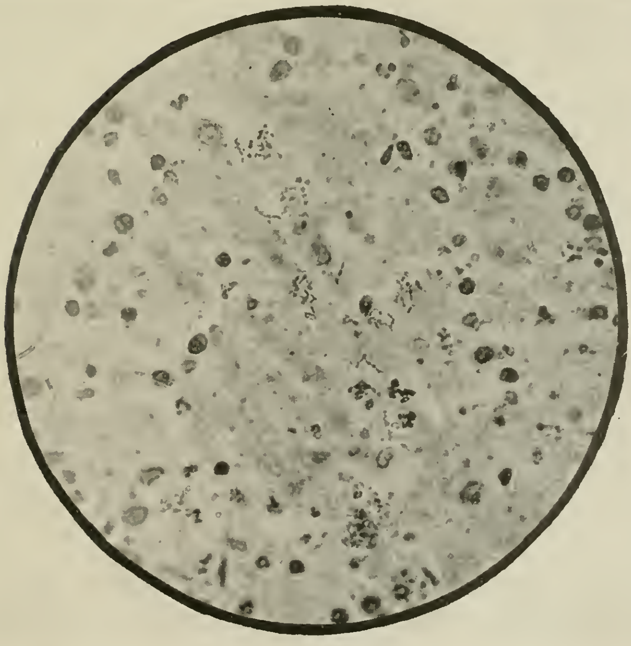

FIG. 4

From this pathological report and from the results of culture, it may be seen that in cases of chronic prostatitis, no one particular organism can be regarded as specific. Another significant feature is the variety of organisms exhibited in any one case. Taking into consideration the fact that only the usual routine culture methods were employed for the demonstration of all organisms other than gonococcus, it seems quite probable that additional types might be found if more elaborate technique were employed, and assuming that all varieties of bacteria present in the prostate were obtained in the small amount of secretion cultured.

The antibodies produced as a result of vaccine administration circulate in the blood stream, and in order to exert a specific action, they must come into intimate contact with the organisms against which they are directed.

The bacteria lodged in the exudate filling the lumen of the glandular spaces and ducts are well removed from the vicinity of any vascular channel and consequently the antibodies associated with the blood stream; these antibodies are presumably of colloid nature and as such have very little power of penetration. In this site they have the additional advantage of a regular fresh supply of prostatic secretion which is continually being formed and mechanically freeing them to a certain extent from the inhibitory action of their own toxins. In view of the histological picture presented, it can be seen that the bacterial colonies are harboured in a practically ideal and protected site. Any treatment, unless it insures the mechanical removal of the contaminated secretion and maintains the patency of the ducts leading from the prostatic acini, cannot hope to prove efficacious, and is merely conducive to bacterial propagation.

Taking these factors into consideration, it seems hardly likely that any marked permanent benefit should be expected from vaccine administration. This point was generally evident in the series of cases coming under our observation during the course of this investigation.

Whether vaccine therapy used in conjunction with massage has any decided advantages over a straight-out, well regulated course of massage and dilatation is doubtful.

In this study the results obtained did not justify vaccine therapy being regarded as a valuable therapeutic adjuvant in the treatment of chronic prostatitis.

CONCLUSIONS

In cases of long-standing chronic prostatitis, the gonococcus was never recovered from the prostatic secretion, although culture methods were employed extremely favorable to its growth.

Autogenous vaccine failed to produce any marked permanent effect on the cause of a chronic prostatitis, which we consider due to the histological structure of the gland under these conditions.

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SEMINAL VESICULITIS AFTER PROSTATECTOMY DUE TO INFECTION WITH MICROCOCCUS CATARRHALIS

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This case is worth reporting because it calls attention to a condition rarely mentioned in literature—acute and chronic seminal vesiculitis after prostatectomy—and because it is the only case I have been able to find where a seminal vesicular infection with the micrococcus catarrhalis has been reported.

It illustrates the possibility of seminal vesicular infections being the cause of continued or recurrent fevers after prostatectomy, of discomforts and pains usually ascribed to the prostatectomy wound, and of a continuation of urinary disturbances such as increased frequency of urination and burning on urination.

On April 17, 1919, a man of sixty-eight years of age came to me, suffering from an almost complete retention of urine. The past history was unimportant, except as noted below—there having been no history of genito-urinary or other infections which could have been associated with the present illness.

For fourteen years he had been having the usual slowly developing symptoms of obstruction to urination due to prostatic hypertrophy, but, besides getting up four to five times at night, he had no discomfort or serious trouble with the obstruction until an attack of "influenza" which he had acquired about three or four weeks previously. From then the urinary obstruction had gradually grown worse until he was voiding every little while and passing only small amounts of urine at a time.

On admission to the hospital, catheterization showed a residual urine of about 720 cc. (24 ounces) with a bladder capacity of about 1200 cc. (40 ounces). The urine was slightly cloudy and contained a small amount of pus and a few staphylococci and a few bacilli morphologically like colon bacilli. In appearance he was a fairly ill man—due no doubt to the effects of the "influenza" as well as to the urinary obstruction. The temperature was 98.2°, pulse 90, respiration 20. But, under suitable treatment he soon improved—having a little afternoon rise in temperature for three or four days only, and no more fever until after operation. Rectal examination showed what seemed to be a fairly large hypertrophy of the prostate which was so situated that it was difficult to reach above it. Cystoscopic examination was never satisfactory, because such examinations were unusually painful but, more especially, because the longest cystoscope which I could find would not more than reach over the top of the projecting vesical hypertrophy.

A little over two months intervened between admission and operation. This was due in part to the necessary pre-operative preparation and in part to extraneous circumstances. The intramuscular injection of 6 mgm. (1 cc.) phenolsulphonephthalein showed at first only about 27 per cent output for the first hour but increased shortly to 40 per cent where it remained until operation. Catheterization at first was very painful due to a great tenderness in the prostatic urethra and it was not until the last few weeks before operation that he was able to stand a retained catheter with anything like comfort. Catheterization was necessary throughout the pre-operative treatment, for he voided very little and then only when the bladder was considerably over distended. It was quite painful for the first few weeks, but better tolerated later. There was, especially at first, but also throughout the pre-operative treatment a difficulty experienced in getting the urine to flow out continuously through the catheter. Often a good deal of manipulation was required to empty the bladder.[1]

Routine examination revealed no other trouble in the genito-urinary tract nor elsewhere and but for the genito-urinary lesions and the usual changes seen in a man of sixty-eight, he was physically and mentally normal.

On June 24, 1919, I performed a suprapubic prostatectomy and was surprised to find that the prostatic enlargement was no greater than I then discovered it to be. The length of the urethra evidently was due to the patient's very deep pelvis and not as I had thought to the extension of the hypertrophied prostate outwards into the bladder. The gland was not readily removed, being quite adherent. Its weight was 33 grams after fixation in 10 per cent formalin.

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[1] I found nothing in the bladder at the time of operation to explain this and there was not enough pus and mucus in the urine at the time to produce a stoppage of the catheter.

The first post-operative difficulty which I encountered was an extreme sensitiveness of the bladder which would not permit the presence of any kind of a drainage tube which extended into the bladder beyond the bladder wall, and almost every kind was tried. This began in twelve to twenty-four hours after the operation and persisted for four to five weeks.

The next was recurring attacks of fever with chills, or chilly sensations, during which the patient felt very badly but suffered no localized discomfort nor pain. They were accompanied by fever and were usually, I found, relieved by a large dose of castor oil, even though the bowels were already moving freely.

On the fifteenth day, he developed a right-sided vasitis and epididymitis which was unusually mild and only involved the lower part of the epididymis. On the two days preceding this attack, there was some fever (on the thirteenth, 101.3°; fourteenth, 100° most of the day, with highest 101.4° but on the sixteenth, seventeenth, eighteenth and nineteenth day, temperature was practically normal, not going as high as 99—until it reached 99.2° on the afternoon of the nineteenth day.

On the twenty-ninth day, his worst attack of fever began and he was extremely ill for several days. Already weakened by the previous attacks of fever, I was in doubt as to whether he would live. Dr. Stewart Roberts was in charge of the medical side of the case and like me, he was at a complete loss to explain the fever. About the thirty-fourth day, he coughed up some sputum which was like that usually seen in pneumonia and there were some fine râles in the lower back parts of the chest. We then thought he might have pneumonia, but we now feel sure that the symptoms and findings were due to pulmonary changes accompanying his weakness and the four or five days he had been lying flat in bed (hypostatic congestion).

During this attack and also during the attack of epididymitis, and subsequent to this attack, rectal examinations were made but nothing of any importance could be discovered. I was never really satisfied with the examinations, for, in the first place, I had to be careful about making any pressure about the prostatectomy wound, for fear of breaking up any venous thrombi and thus producing a pulmonary embolus; and secondly, the seminal vesicles were located so high in the pelvis that I was doubtful as to whether I was reaching them.

Recovery from this attack was slow, but was followed by much less severe attacks, and only slight elevations in temperature during the remainder of his stay in the hospital—from about the thirty-seventh day until the fifty-fourth day.

He was by no means well when he left the hospital on the fifty-fourth day, for the wound had not healed, he was quite weak, far below his normal weight, the urine was quite cloudy with much pus and many microörganisms.

At home there was a slow but very decided improvement, though the urine did not become much clearer, the suprapubic wound did not heal and a considerable increase over normal in the frequency of urination continued after the tube was removed from the suprapubic opening, and at times there was a good deal of burning on urination. In about three months he returned to the hospital for me to attempt to hasten the closure of the suprapubic wound. On November 3, I began irrigations of the bladder, curettement of the wound, etc. Thirteen days later (on November 16), without explainable cause, he suddenly began having fever again and a pain in the lower left side of the abdomen where there seemed to be actual tenderness to pressure, but nothing else to be found. Dr. Roberts saw him again, and Dr. Floyd McRae, Sr., without any of us being able to suggest a reason for the fever. Because of the cloudy urine and pain in the lower left side and because I had never yet been able to find anything which would explain the attacks of fever, I thought there might be an infection of the left kidney. Four days after the attack started, I did a cystoscopy and attempted ureteral catheterization. I was not able to catheterize the ureters but, much to my relief, the patient's temperature went to normal and stayed there.

A few days later, I did another cystoscopy and ureteral catheterization, and was able to collect enough urine from each side to assure me that I was wrong in my supposition about a kidney infection; the urine seemed to be normal.

Under bladder irrigations, and treatments of the suprapubic opening, I managed to get the suprapubic wound to gradually heal and I think to clear up the cloudiness in the urine a little, but not to any great extent. There was still a good deal of pus and mucous in the urine, and he was voiding every hour or hour and a half.

On February 13, 1920, I decided, on one of his frequent visits to Atlanta, to satisfy myself about the condition of the pelvis in the region of the bladder by making a vigorous rectal examination, regardless of how much discomfort it caused him. This I did and found, on the right side especially, a large area of increased resistance which suggested a long standing inflammation about the seminal vesicles. Neither seminal vesicle could be distinctly outlined, nor as far as feeling anything was concerned was the examination entirely satisfactory, for due to the great depth of the pelvis, it was only by the most vigorous effort that I was able to reach as high as the vesicles.

I was not long in doubt, however, as to what the trouble really was, for a catheter passed into the bladder, immediately after the rectal examination, withdrew about 50 cc. of a very thick fluid which was a dirty, greenish-red color and gave off a very foul odor.[2] Microscopic examination of the material showed many broken down cells, a good deal of mucus and pus and a great many red blood cells. Cultures made then and later showed the following organisms: Staphylococcus, colon bacillus and micrococcus catarrhalis (Dr. Stewart Roberts' laboratory).

I began then to give the patient regular massages of the seminal vesicles and improvement was noted at once. On March 12, 1920, which was soon as the patient could arrange to come to Atlanta to stay, I attempted to inject the seminal vesicles through the vasa deferentia with a solution of Collargol, but without success, as was shown by the X-ray examination made immediately after the operation. This failure I attribute to the dilatation of the ejaculatory ducts due to inflammation in and about them, or to the intermittent passage of the thick material from the infected vesicles, or to the destruction of these ducts by the prostatectomy.

The treatments, consisting of massage of the seminal vesicles, followed by irrigations of the bladder, were resumed and a steady improvement in the frequency of urination and the cloudy urine was noted. After I discovered the trouble, the patient began to watch his urine more closely and observed at times that the seminal vesicles emptied themselves either before or during urination—for at times the urine would be very cloudy and of foul odor, or at the end of urination, he would pass the muco-purulent material from the vesicles, which was easily recognized by the color and odor. Massage given after these discharges expressed much smaller quantity of the muco-purulent material than was usually found at other times.

The treatments were gradually given at less frequent intervals and about six months after they were begun, he was voiding every three to four hours (once at night) and the urine contained only a little pus and some organisms resembling colon bacilli in morphology. His weight was normal and he was in excellent health.

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[2] The consistency, odor, and color made me think of the sputum seen at times in cases of subacute or chronic bronchitis.

I have seen the patient only at long intervals since August, 1920, but my reports show that he is perfectly well, that he has no symptoms of genito-urinary disturbance and the urine is uninfected.

CONCLUSIONS

The intermittent attacks of fever after the operations were undoubtedly caused by the seminal vesiculitis. This infection of the vesicles, since it was with the micrococcus catarrhalis, probably took place before the operation, during the time he was sick with what he thought was an attack of influenza, and the inflammation and swelling in and about the vesicles probably assisted in the production of urinary obstruction. The great tenderness in the posterior urethra which we noted on catheterization (a degree rarely seen in prostatic hypertrophy cases) could very well have been produced by the vesiculitis and the naturally associated posterior urethritis. The rise in temperature immediately after the operation, with the great irritability of the bladder and (as I later recognized) the unusual discomforts in the lower part of the abdomen, were in great part due to an exacerbation of the seminal vesiculitis. Another exacerbation of the inflammation on the thirteenth and fourteenth days resulting in an extension of the infection to the epididymis gives evidence of the activity of the infection.

The fact that the intermittent attacks of fever were nearly all relieved by castor oil and one severe attack stopped immediately after a cystoscopic examination, suggests an emptying of the vesicles by straining at stool and by the straining on and after passing the cystoscope. That I did not discover the discharge from the vesicles which probably occurred at the cystoscopy was due to the fact that the examination was abruptly terminated—the cystoscope withdrawn, because the patient could not bear the pain. The later examination was made after a hypodermic injection of morphine and scopolamine.

THE EFFECTS OF INJECTING COLLARGOL INTO THE VAS DEFERENS

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Surgical operations on the vas deferens are not uncommon and not at all recent. In 1895 C. H. Mayo (1) described a method for the union of the severed vas by the use of a cat gut splint. Lydston (2), Richter (3), Roberts (4), McKenna (5), etc., have also reported favorable results following operations on the vas. The surgical management of gonorrheal infections of the epididymis, vas, and seminal vesicles was, however, limited to procedures which provided drainage of retained pus under pressure until Belfield (6) in 1905, described his method of injecting the vas and vesicle through a needle introduced into the vas just above the epididymis. In this early report the method was not described in detail but observation on a large number of cases showed that this procedure was very efficient in the treatment of chronic infections of the vas and vesicles and the method was accepted rather generally.

At present, vasotomies are done quite commonly, although the original technique has been modified somewhat because of the great difficulty experienced by most surgeons in getting the needle into the lumen of the vas. The operation is generally performed as follows: The skin of the scrotum is shaved and cleaned as for any surgical procedure. The seminal vesicles are massaged and emptied so that the maximum amount of collargol will enter and be retained. After infiltration of the skin with novocaine the vas is picked up under the skin of the scrotum and an incision made over it. The vas is exposed and the sheath is carefully peeled away. A longitudinal incision is then made through the vas, large enough to permit the introduction of the needle which is usually curved and blunt pointed. On account of the severe complications from failure to get the needle into the lumen several methods have been devised to overcome this danger. Thus a silk worm thread is usually introduced into the lumen first and passed up the vas, followed by the introduction of the needle along the thread, which is then withdrawn; or sterile water is injected after the introduction of the needle to see that there is no leakage. When the needle is in the lumen about 5 cc. of a 5 per cent solution of collargol is slowly injected with a Luer syringe into the vas towards the vesicles. The needle is then withdrawn and any collargol which oozes from the wound is quickly sponged up. The vas is massaged over the inguinal canal towards the scrotum so that no excess of collargol remains to be regurgitated. When all oozing has stopped the vas is replaced and the skin closed with one or two silk worm sutures.

The destructive action of collargol on the tissues has been demonstrated in connection with its use as an opaque medium for making pyelograms. Eisendrath (7) has pointed out the action of this substance on the kidney parenchyma when injected into the kidney pelvis.

Although vasotomy is an apparently simple operation it is not uncommonly followed by serious complications. Probably the most common complication of vasotomy is the regurgitation of some of the injected fluid at the site of injection. This gives rise to a painful, tender swelling which remains for a long time as an infiltrated hard nodule. Another complication, which, though uncommon, occurs often enough to be worthy of serious consideration, is the regurgitation of a sufficient amount of collargol to cause an infiltration of the surrounding tissues, giving rise to extensive necrosis and sloughing associated with marked pain, high fever and severe constitutional symptoms. The infiltration may spread along and involve the perineal and suprapubic tissues and resemble an extravasation of urine. This complication is not one for the novice alone to fear as it has happened to experienced surgeons.

Recently, still another question of utmost importance has arisen regarding the possibility of producing a stricture of the vas and sterility by the injection of collargol into it. Perhaps it is true that many surgeons have patients who have not been made sterile by bilateral vasotomy but on the other hand cases of sterility present themselves, often in the form of law suits, and the question arises as to the rôle played by the vasotomy in the production of the stricture of the vas. In looking over the literature on the subject we have been unable to find any references to experimental work to show the effects of collargol injections into the vas deference. With this question in mind the following experiments were carried out.

Large male dogs were used. The technique employed was essentially that described above and the operations were carried out under strict aseptic conditions. About 3 cc. of a 0.8 per cent solution of cocaine was used for infiltrating the skin. The incision was about 1½ inches long, the center lying over the superior pole of the testicle. The cord was exposed and the vas freed. A safety razor blade was used to make the small nick in the vas and about 2 cc. of a 5 per cent solution of collargol was injected slowly through the needle introduced into the lumen of the vas. To prevent regurgitation of the collargol, the needle was held in place by a forceps during the injection, but very little pressure was used in this step. After withdrawal of the needle the wound was carefully watched for any oozing of collargol from the site of injection, the cord was allowed to slip back into place, and the skin closed with silk worm sutures. The wound was dressed with collodion and gauze dressings. At intervals noted below the animals were anesthetized and the vas removed for gross and microscopical examination. The results obtained are tabulated below.

Dog 1. Thirty minutes. Right vasotomy, March 1, 1923. The dog was killed at the end of thirty minutes and both vasa removed. The left side was used sa a normal specimen; the right side showed no changes grossly except for a slight hyperemia. The collargol could be seen within the lumen and was also found within the bladder and urethra. Microscopically, the sections revealed the collargol in the lumen and about the epithelial cells. There was very little reaction, only a few polymorphonuclear cells infiltrating the mucosa. The vessels were markedly dilated and congested (fig. 1).

Dog 2. Twenty-four hours. Left vasotomy, March 20, 1923. Killed March 21, 1923. Grossly, the vas was thickened, markedly congested, and edematous. Collargol was seen in the lumen and was also present in the bladder and seminal vesicles. At the site of injection there was considerable fibrinous exudate. Microscopically, marked congestion and edema of the entire vas was seen; but this was most

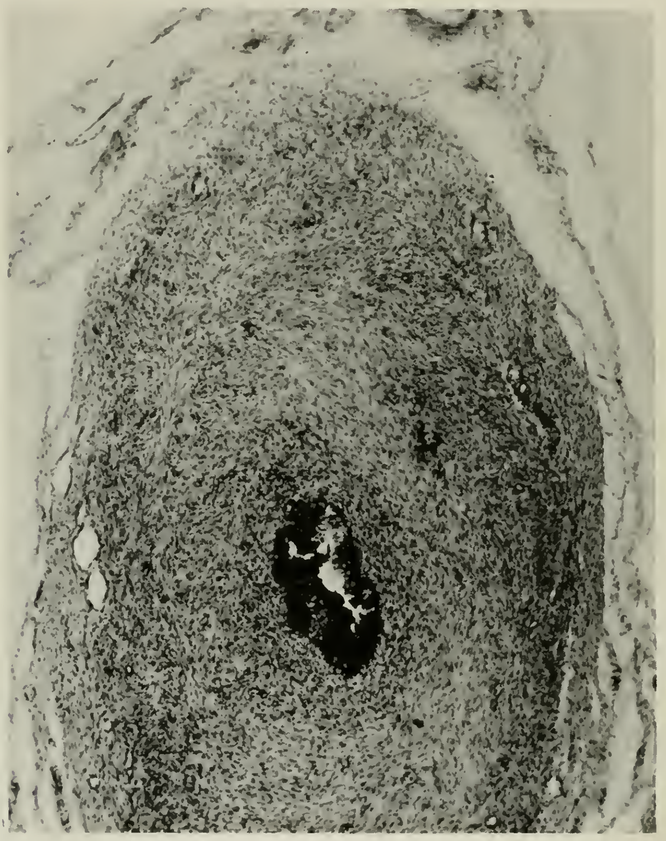

FIG. 1. VAS THIRTY MINUTES AFTER INJECTION, SHOWING COLLARGOL IN THE LUMEN

marked in the mucosa. Within the lumen was collargol, along with many polynuclear leucocytes, degenerated blood cells, and degenerated epithelial cells. Practically the entire epithelial lining was destroyed and all the coats were infiltrated with polymorphonuclear cells. This infiltration was most marked in the mucosa which was densely infiltrated and in the muscle layer beneath the mucosa. The changes here were those of an intense inflammatory reaction to chemical injury (fig. 2).

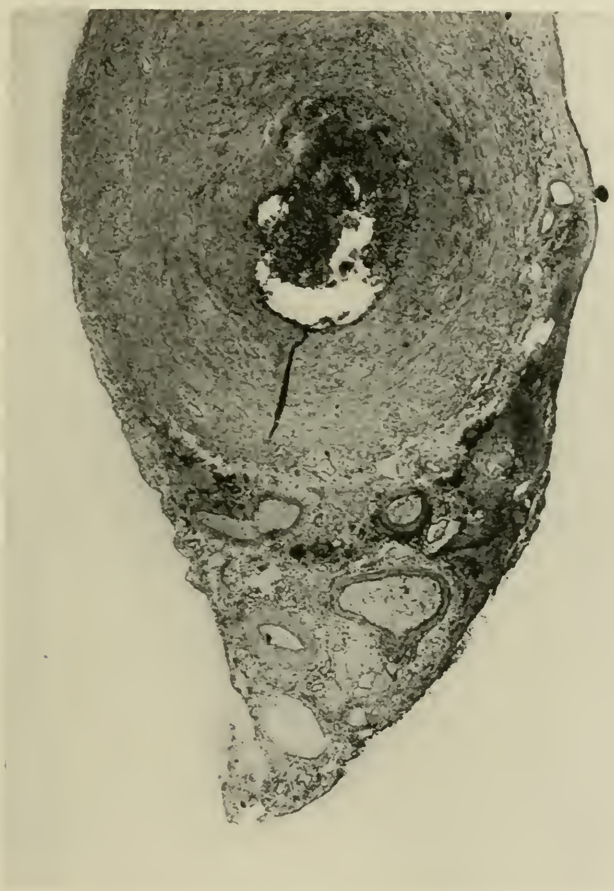

Fig. 2. Vas Twenty-Four Hours after Injection, Showing Destruction of Epithelium and Round Cell Infiltration of Mucosa

Dog 3. Forty-eight hours. Left vasotomy, April 9, 1923. Vas removed April 11, 1923. The vas was markedly injected and edematous. There was collargol in the lumen and at the site of injection was a fibrinous exudate. Microscopically, at the site of injection the lumen was seen to be filled with collargol, cellular debris and polymorphonuclear leucocytes. The epithelium was destroyed. The mucosa and muscle layers were markedly edematous resulting in the separation of the fibers of the mucosa and of the muscle bundles of the muscularis. In the muscle layers the blood vessels were dilated and engorged. The serosa was edematous and infiltrated with polymorphonuclear leucocytes. There was a rather marked deposit of fibrin on the serosa which was also infiltrated with round cells. A section taken about 6 inches distally from the site of injection showed practically the same changes except that they were less intense and there was no deposit of fibrin on the serosa.

Dog 4. Ninety-six hours. Right vasotomy, March 24, 1923. Killed March 28, 1923. Grossly, collargol was still seen in the lumen. At the site of injection the vas was markedly edematous, congested, and hemorrhagic for a distance of about three inches. There was a black fibrinous exudate on the serosa at the site of injection which was beginning to become adherent to the surrounding structures and caused a slight kink in the vas. Microscopically, at the site of injection the lumen was seen to be filled with leucocytes, degenerated blood, destroyed epithelial cells, and collargol crystals. The epithelium was entirely destroyed there was a marked edema of the mucosa and muscle layers associated with a round cell infiltration of these layers. The vessels of the muscle layers were dilated and congested and associated with a dense perivascular round cell infiltration. The serosa was very edematous and congested and greatly infiltrated. There was an exudate of fibrin and leucocytes on the serosa. Distal to the site of injection the changes were essentially the same but less marked, and there was no exudate on the serosa (fig. 3).

Dog 5. One week. Left vasotomy, March 7, 1923. Killed March 14, 1923. Grossly, the skin incision was healed and was clean. The vas at the site of injection was thickened, hard and congested. There was a fibrinous exudate which was becoming fibrous in nature at the site of injection and on account of the adherence to surrounding structures was causing considerable deformity of the vas. Distal to the site of injection there was little gross change other than congestion and edema. Microscopically, at the site of injection the lumen was intact, there was an edema of the mucosa with a round cell infiltration. This infiltration was made up largely of polymorphonuclear cells but there were a few lymphocytes. The vessels were dilated and congested. The changes in the vas distal to the site of injection were practically the same.

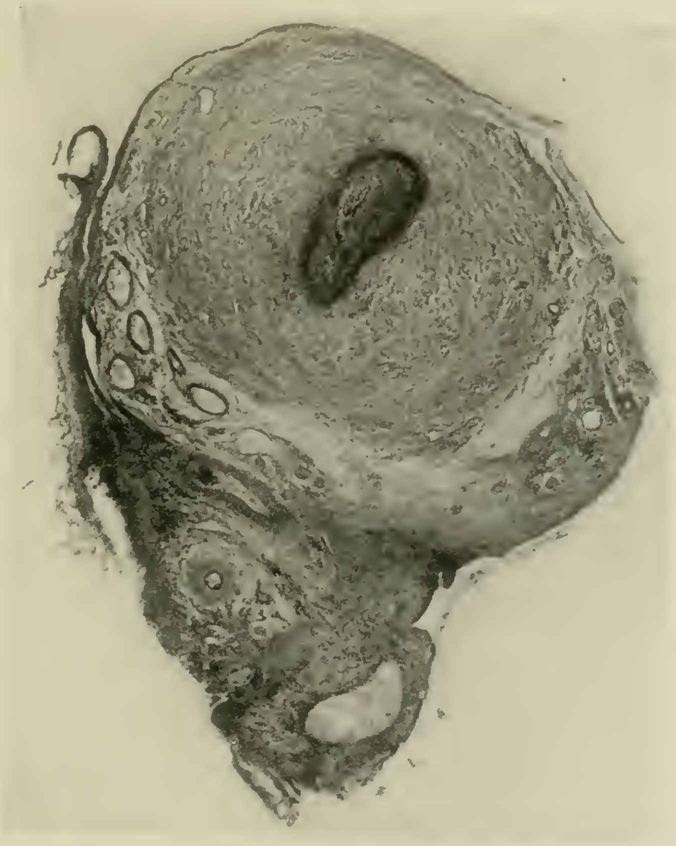

FIG. 3. VAS NINETY-SIX HOURS AFTER INJECTION SHOWING LUMEN FILLED WITH DETRITUS, MARKED ROUND CELL INFILTRATION AND EDEMA OF MUCOUS AND MUSCULAR COATS

Dog 2 (b). Two weeks. Right vasotomy, March 7, 1923. Killed March 21, 1923. Grossly, at the site of injection, the vas was covered with a fibrinous exudate which was adherent to the surrounding structures so that the vas was kinked at this point. The vas felt indurated and the sheath was thickened; there were fibrous tags on the surface.

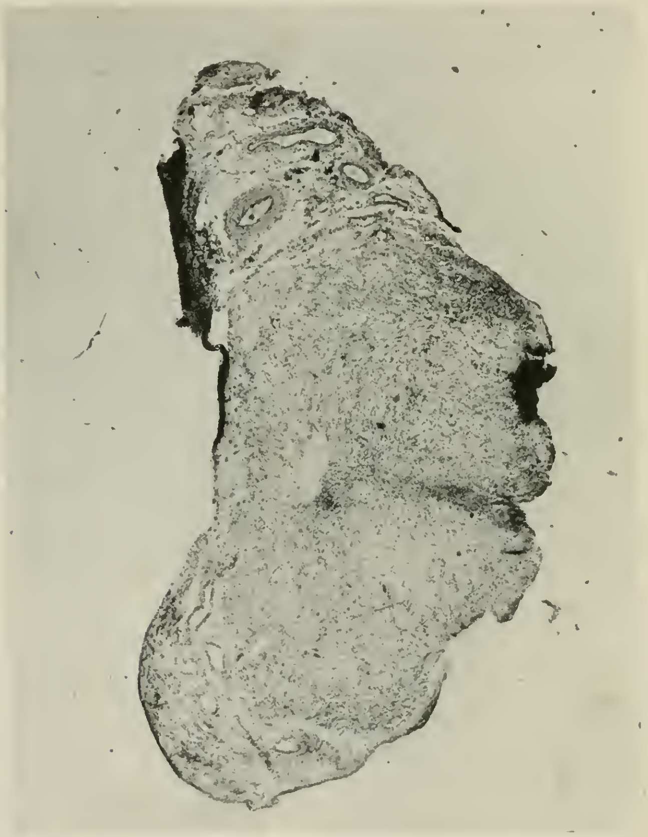

Fig. 4. Vas Two Weeks after Injection, Showing Stricture

Distal to the site of injection there were no marked gross changes. Microscopically, at the site of injection a leucocytic infiltration at the site of the lumen. This infiltration was composed largely of polymorphonuclear leucocytes with some lymphocytes. The lumen was entirely filled with numerous proliferating fibroblasts which completely obliterated it. There was a round cell infiltration involving the muscle layers. Just under the serosa there was some blood pigment and many phagocytic round cells containing coarse pigment granules. There was also a proliferation of fibroblasts in this area and a deposition of black pigment granules. The serosa was covered with organizing fibrin infiltrated with round cells. At this stage there was a definite stricture obliterating the lumen of the vas at the site of injection. About 6 inches distal to the site of injection the sections showed a flattened epithelium lining the lumen. There were a few round cells in the mucosa, very little dilatation of the vessels, and the acute inflammatory changes seen in previous sections seemed to be subsiding but as the site of injection was approached the changes became more marked. Serial sections at this stage showed practically all of the pathology at the site of injection (fig. 4).

Dog 3 (*b*). Five weeks. Right vasotomy, March 7, 1923. Vas removed April 11, 1923. Grossly, there were seen many fibrous adhesions between the vas and the surrounding structures so that the vas was permanently kinked and twisted. There was no other evidence of inflammation. Distal to the site of injection the vas appeared normal. This vas was completely excised and a silkworm thread passed into the lumen. Complete obstruction was met with at the site of injection and on splitting the vas at this point a definite fibrous stricture was found completely occluding the lumen. Microscopically, a section of the vas distal to the site of injection showed the lumen patent, there was a regeneration of the fresh epithelium and very little evidence of any acute inflammatory changes. The changes here may be taken to represent complete recovery. The portion of the vas containing the stricture was not examined microscopically but was mounted as a gross specimen.

Dog 6. Control. Operated April 4, 1923. Vas removed April 24, 1923. Right vas was exposed and incised longitudinally. Left vas incised and pressure of forceps exerted as in an ordinary vasotomy. The left vas showed no gross change except for some fibrinous and beginning fibrous adhesions to the surrounding structures causing a kink and a twist at the site of trauma. A silkworm thread met obstruction at the site of the kink but this was easily overcome as the vas was straightened out. The right vas presented essentially the same changes as the left. No obstruction was met at the site of trauma although there was a slight twist at this site.

An effort was made to study the effect of the injections on the seminal vesicles and the prostate, but this proved unsatisfactory on account of technical difficulties.

The results of our experiments indicate that the injection of 5 per cent collargol into the vas gives rise to an intense acute inflammatory reaction. This becomes pronounced at the end of twenty-four hours and causes a high grade edema and congestion involving the mucosa and muscle layers associated with a marked infiltration of polymorphonuclear leucocytes into these layers. At the end of forty-eight hours the reaction is more intense and there is complete destruction of the epithelial lining of the lumen and a separation of the fibers of the mucosa and of the muscle bundles in the deeper layers. Within ninety-six hours the inflammatory process is at its height and in addition to a more marked degree of the changes noted above there is an edema of the serosa and a perivascular round cell infiltration in this layer along with an hemorrhagic exudate visible on the surface of the vas. At the end of a week the changes are still marked but are beginning to subside. At the end of two weeks there is beginning regeneration of the epithelium and at the end of five weeks the regeneration is complete. Collargol can be seen grossly in the vas as late as the fourth day after injections and can be seen microscopically in the form of crystals as late as the second week. The collargol appears in the bladder within thirty minutes after the injection. Some of the animals experienced a diarrhea following the injection of collargol. This is probably explained either on a reflex basis or as due to irritation of the rectum by the inflammation of the vesicles produced by the collargol within them. The pathological changes noted above occur at the site of injection in a more marked degree and in addition there is an exudation of fibrin and round cells which organizes and leads to the formation of fibrous adhesions between the vas and the surrounding structures. This leads to a kinking and twisting of the vas at this point. The most noteworthy change is, however, the proliferation of fibroblasts at the site of the lumen which results in its complete obliteration. This change takes place within two weeks after injection and within five weeks after injection there is a formation of a dense fibrous stricture at the site of injection. To determine the rôle played by the collargol, a control experiment was carried out in which exactly the same technique was employed as before except that no collargol was injected. The results showed that the trauma of operation alone was insufficient to cause a stricture and that it is the highly irritant action of the collargol in addition to the trauma that is necessary for the formation of the stricture, although the kinking and twisting of the vas due to adhesions may cause partial obstruction.

Experimentally, therefore, we conclude that it is quite possible to produce a stricture of the vas by injecting collargol into it and that sterility may result if this change is bilateral.

From a practical point of view, however, if the process is unilateral there is not necessarily any contraindication for the performance of this operation if the operator feels that the infection can be cured by this means. Sterility following bilateral gonorrheal infection of the epididymis is not an uncommon occurrence. Belfield (8) has pointed out that sterility may be due to occlusions of the epididymis and ejaculatory ducts following late in the wake of a gonorrheal infection. Bilateral vasotomy is not, therefore, absolutely contraindicated in cases of bilateral infection inasmuch as the ultimate results without vasotomy are unknown and the presence of a gonorrheal focus may give rise to serious complications.

CONCLUSIONS

The injection of 5 per cent collargol into the vas deferens causes an intense acute inflammatory reaction which results in destruction of the epithelial cells lining the lumen, edema of the mucosa and muscularis, and a dense round cell infiltration into these layers.

At the site of the injection the effect of the trauma, in addition to that of the collargol, results in an exudation of fibrin on the serosa which organizes and becomes adherent to the surrounding structures. This may result in permanent kinks or twists of the vas which can cause partial occlusion of the lumen.

At the point of injection there is proliferation of fibroblasts at the site of the lumen which results in complete obliteration due to stricture formation within two weeks after injection.

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MICROSCOPIC EXAMINATION OF SEMEN TO DETERMINE THE PRESENCE OF SEMINAL VESICULITIS

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There is an important test in determining if a patient has seminal vesiculitis which we think is not sufficiently employed, namely, the examination of a condom specimen of the semen for pus. Not infrequently it is difficult to say whether or not a patient has seminal vesiculitis. If, however, a smear from the prostate gland is stained and compared with a stained smear of semen, we can usually ascertain if the vesicles are inflamed. In this manner we are assisted in differentiating chronic seminal vesiculitis from chronic prostatitis by the number of pus cells found in the specimens.

Pus cells may be found in the semen when the prostate alone is involved but the secretion expressed from the prostate shows a definitely larger number of polymorphonuclear leucocytes.

In order to lessen the chance of urethral pus contaminating the seminal discharge, the patient is advised to urinate just before coitus.

A single negative test is not to be relied upon. It is obviously not advisable to recommend this test in acute conditions.

Before declaring a patient to be cured of gonococcal infection, we request that he submit a condom specimen to be examined for pus cells. If negative it points toward the possbility of his being well, though it is not in itself conclusive evidence.

REJUVENATION EXPERIMENTS WITH VAS LIGATION IN RATS

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INTRODUCTORY

Perhaps no chapter in modern endocrinology is so fraught with interest of a genuine scientific character, on the one hand, and sensationalism on the other, than that of the internal secretion of the sexual glands. Among the most interesting contributions in this field during the past few years are the rejuvenation experiments of Steinach (1), Harms (2), Massaglia (3), Bouin and Ancel (4), and others, of which the work of Steinach has perhaps attracted the greatest attention. This investigator working on rats described the anatomical and physiological changes produced in these animals after ligation of one or both vasa deferentia. He claimed that the old rats which have been operated on in this way exhibited distinct signs and symptoms of rejuvenation as shown by their general behavior, changes in their hair-growth, activity, etc. Somewhat similar experiments were carried out by Bouin and Ancel on rabbits and Massaglia on roosters. The enthusiasm aroused by the experiments of Steinach induced various physicians actually to try the rejuvenation operations on senile men. The results obtained are as yet indefinite and the whole subject requires careful and critical examination. This consideration led to the present investigation in which the authors on a small scale tried to study the effects of vas ligation on rats.

METHODS OF STUDY

Twenty-two rats were studied altogether in the present investigation. All of these animals were over one year old and showed marked signs of senescence. Six animals were operated on and had their vas deferens carefully tied off. Two others had a laparotomy performed but the vasa deferentia were not ligated and these animals served as controls. The above 8 rats were kept for several months, and their general condition and behavior were noted. The other 14 rats were studied more carefully by two special methods; some were trained in a circular maze and their cerebral and nervous efficiency studied in that way. Another group were trained on the rope and their neuromuscular coördination was studied by that method. Of the 14 rats, 2 had both vasa deferentia ligated, 5 rats had only one vas deferens tied off, 4 of these 7 were trained on the rope while 3 were trained in a maze. Seven other rats were used as controls, that is these were operated on under anesthesia but the vasa deferentia were not tied off. Four of the controls were trained on the rope, while 3 of the controls were trained in the maze.

EFFECT OF VAS LIGATION ON THE BEHAVIOR IN THE CIRCULAR MAZE

The method employed in these experiments has been described in a paper on the effect of Prostatectomy on Albino Rats published elsewhere (5). The apparatus used was a circular maze with seven concentric runways. The rats are taught to find their way from the entrance, the periphery, through the labyrinthian runways to the center of the apparatus, where food is placed. After sufficient training the animals can find their way to the center of the maze without running into blind alleys and in a very short period of time. In this way the effects of drugs, operation, etc. can be studied as described more fully elsewhere.

As stated above 6 rats were studied altogether by this method. Three of these were laparotomized without ligation of the vas while 3 others had their vasa deferentia ligated. The operation was performed on the controls on October 20, 1922, and on the other 3 rats on October 23. The training of the control rats was begun about a week after the operation when the animals were completely recovered from the effects of the anesthesia and the operative procedure. The training of the ligated rats in the maze was begun on January 4 and January 9, 1923, that is about two and one-half months after the ligation of the vasa deferentia. Careful observation of the behavior of the two sets of rats in the maze revealed *no definite difference in the behavior between the operated rats and the controls.*

EXPERIMENTS ON THE ROPE

The method employed here was the same as used by Macht and Ulrich (6) in a study of the effects of prostatectomy on integration of muscular movements. A medium sized cotton rope 1 cm. in diameter and 210 cm. in length is stretched tightly from one end of a room to the other at the height of about 6 feet from the floor. At each end of the rope is built a small wooden platform about 9 inches square, the surface of which is in the same plane with the rope. White rats are trained to cross the room on the rope from one platform to the other. The experiment is begun by placing a dish of food on one platform and placing a rat on the rope a few feet away and allowing the animal to reach to the platform. On the following day the rat is placed a little further away from the food platform. On the third day the rat is placed on the rope at its middle, and on the fourth day, the experiment can generally be begun by placing the animal on the platform at the other end and allowing the rat to cross over the entire length of the rope. This method allows a study of progression along a narrow path with the limbs of the animal converged inward and not separated in a natural way when progressing on a flat surface. At the beginning of training, progression along the rope is just barely possible with most of the rats. The animals make numerous slips, progression is arhythmic and the body is crouched and poorly adjusted to progression along the rope. There is usually marked trembling of the entire body musculature with a swaying of the hind quarters.

Frequently loss in equilibrium occurs and the rat becomes suspended by the forelegs, from which position it readjusts itself with difficulty and crawls forward to the food platform.

On continuing the training rhythmic progression along the rope appears from the fifteenth to the twentieth day of trial. This rhythmic progression is first noted in the front limbs while the hind limbs are lowered and are swaying. As the adjustment is bettered the hind quarters stand more firmly on the rope and are no longer crouching but are erected during the progression; so that after succeeding trials the animals run with both fore and hind legs erect, moving rhythmically, without slipping or loss of equilibrium. When this stage has been reached, it is noticed that the body musculature is much firmer and better developed. All of the muscles, the abdominal and especially those of the limbs, feel harder and appear to have increased in tone. These changes in the muscles must take place for efficient adjustment of the body in order that progression may be rhthymic.

Eight rats were used in the rope experiments. Of these 4 were operated on October 23, 1922, and had their vasa deferentia ligated unilaterally in 3 and bilaterally in 1. Four rats were operated on as controls, that is, laparotomy was performed but the vasa deferentia were *not* ligated. The results obtained in the rope experiments were perhaps the most interesting of the whole series of investigations performed by the present authors. With the behavior on the rope as the criterion of the muscular strength and coördination a very marked difference was noted between the control rats and the ligated rats. The control rats were all so old that they required a very long time to learn, even imperfectly, to cross the room on the rope from one end to the other. These animals partly through weakness and partly through their heavy weight were unable to walk on the rope perfectly balanced but continually slipped off and remained hanging by their front legs or aided by their tails. It required about six weeks of daily practice to train the control animals to cross over from the one platform to the other even with numerous mistakes. On the other hand, the vas ligated rats were seen to be distinctly more agile and stronger in learning the rope problem. These ligated rats learned to cross from one platform to the other more rapidly and with fewer slips within two weeks of the time after the beginning of training. The ligated rats were also very large and heavy and for this reason they also slipped occasionally but the difference between the controls and these rats was quite striking from the beginning of training as indicated by these very slips. While the control rats when slipping off the rope were unable to pull themselves up but remained hanging by their forelegs until taken off by the experimenters, the *ligated* rats were able to pull themselves up and continue on the rope until they reached the opposite platform. This difference was very constant in occurrence, but this marked improvement did not last for long. After a period of about six to eight weeks the ligated rats began to deteriorate and gradually returned to their senile condition previous to the operation.

OTHER CHANGES

All of the 22 rats were carefully observed in regard to their general behavior, nutrition, growth of hair, etc.

Weight. No marked difference in weight was noticed between the control rats and those in which the vasa deferentia were ligated. Thus for instance, on October 26, 1922, 7 control rats weighed 245, 185, 218, 242, 245, 235, and 225 grams respectively, the average being 228 grams. On February 22 the same rats weighed 331, 260, 280, 286, 246, 307 and 292 grams respectively, giving an average of 286 grams. The average increase in these control rats was 58 grams or 25 per cent. All of the animals in the above investigation were fed on milk and bread. The weights of the ligated rats on October 26 1922 were 216, 252, 269, 188, 192, 237 and 258 grams respectively, the average weight being 230 grams. On February 22, 1923, or four months after the operation, their weights were 267, 277, 318, 301, 246 and 279 grams. This represented an average gain of 49 grams, or 21 per cent of the original weight. It is evident that there is very little difference in respect to increase in weight between the controls and the other rats.

GENERAL APPEARANCE

All of the rats at the beginning of the investigation being advanced in age, presented a characteristic senile appearance. They were not as agile as younger rats, their coat of fur was shaggy and dull in lustre, the eyes were dull and not glistening as in younger animals. The rats sat or lay quietly in the cages and were indifferent to their surroundings except when hungry. After vas ligation a number of rats showed distinct improvement in their general appearance and behavior. They were more active and several of the animals developed a new coat of fur, that is, in place of the shaggy and scanty hair the fur became more lustrous and heavier. These changes persisted for several weeks but here again as in the case of muscular coördination, the animals gradually lapsed into their usual senile state.

DISCUSSION

The total number of animals studied in the present investigation was rather small, nevertheless some interesting data are furnished as the result of the experiments. It will be noted that as regards the behavior in the maze, that is as regards the cerebro-spinal efficiency of the rats, no improvement was noted after ligating the vas deferens. On the other hand, distinct improvement in muscular coördination and strength of the muscles was exhibited by the animals which were studied by means of the rope problem. Equally interesting is the fact that this amelioration or improvement in the animals was of a temporary character, lasting only through a few weeks and the animals gradually lapsed into their usual senile state. The few other changes in general appearance of the fur, eyes, etc., were also of a transient character. All of the changes noted seem to have been the resultants of the vas ligation, yet such an assertion can not be positively made without numerous experiments. The results obtained however, warrant a further investigation of the subject.

SUMMARY

1. The effect of ligation of the vas deferens in senile rats was studied on their behavior in the circular maze, their muscular coördination, weight and general appearance.

2. No change was produced in the behavior of rats in the circular maze.

3. A definite improvement in the muscular coördination muscular efficiency and general appearance of the rats was noted but it was of a transient nature.

4. The results of the experiments warrant further investigation of the subject.

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NOTES ON SUPRAPUBIC PROSTATECTOMY[1]

BASED ON AN ANALYSIS OF 100 CONSECUTIVE CASES

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So much has been written on this subject that one feels like prefacing any further contribution with an apology. Nevertheless, while wonderful strides, familiar to all of us have been made in the last two decades, I believe there is still room for a great deal of further progress. I have a feeling that the mortality statistics expressed in terms of published articles by skilful urologists is a far cry from the true mortality as applied to the large number of operations being done throughout the country, which are not, and probably never will be reported. I believe if we could get a true picture of the mortality and morbidity and poor end results obtained by the average urologist, the average general surgeon, and the average occasional operator it would, to say the least, be a rather startling picture. I believe it is fair to assume as one of our individual functions and one of the functions of this Society, an effort to, so far as possible, so standardize and simplify methods of procedure as to make this operation safe in the hands of the average operator.

So far as I know no person has approached the remarkable results obtained by Young, of Baltimore, with his own method of perineal prostatectomy. In spite of this I believe the suprapubic route will continue as the popular method of attack. In most clinics, except those of Dr. Young, himself, and those of the men trained immediately under him, perineal prostatectomy is elected only in the exceptional case while the suprapubic operation is the one of choice.

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[1] Read at the meeting of the American Urological Association, Rochester, Minn., May 21, 22 and 23, 1923.

While admitting that much of Dr. Young's remarkable results may be attributed to his superlative degree of skill, it seems fair to assume that some part of it is due to the fact that this operation has been developed entirely by one man and that every detail of the procedure has been gradually and definitely standardized. This certainly cannot be said of the suprapubic operation. In fact if we include the various details, each of which is important, there would seem to be as many variations of procedure as there are operators. While, of course, I realize that we cannot always abide by hard and fast rules, and that every case presents its own special problems, nevertheless it does seem to me that we can eventually agree upon some standards of procedure which will approach the ideal and which will be subject to fewer and less radical variations. This then is the object of my paper: to contribute my mite towards that end.

The following notes were made from an analysis of 100 consecutive cases occurring in my service at the Brooklyn Hospital over a period of about three years.

The age distribution was as follows:

	Number of cases
Fourth decade	2
Fifth decade	14
Sixth decade	46
Seventh decade	32
Eighth decade	6

The youngest case was in a man of forty-six; the oldest, eighty-seven. The length of history varied from one day to twenty years; the average being three and a half years. The patient with the one day history had acute and complete retention as his first and only symptom.

Length of history table:

	Number of cases
Less than one year	27
One year	13
Two years	19
Three years	9
Five years	10
More than five years	22

Five cases had lead a catheter life for one year or more. One of these, a particularly interesting case, was a man of seventy-nine who had led an absolutely catheter life for thirteen years and only came to operation when neither he nor his family doctor were able to pass a catheter. He made an uneventful recovery.

Fifty-three patients in this series were admitted with complete retention, all but 2, acute. Some of these applied directly for relief, most of them, however, had been subjected to repeated catheterizations over a period ranging from one day to three weeks by their family doctors, and finally sought relief because of the increasing difficulty or inability to pass a catheter. Two cases had paradoxical incontinence. The remaining 45 had residual urine ranging from 2 ounces (2 cases) to 16 ounces plus. No residual of more than 16 ounces was noted, as this is the largest amount ever removed at one sitting. If the bladder is distended beyond this point, it is gradually emptied with an indwelling catheter and a clamp removed at hourly intervals, evacuating 4 to 6 ounces on each occasion until it is empty.

The amount of residual urine leads me to a very brief consideration of the indications for operation: Complete retention, if the case is operable, is to my mind an absolute indication. Two ounces or more of residual urine in a vigorous man of sixty or under, who has a definite bladder neck obstruction, is a clear indication. Two, 3 or 4 ounces of residual urine in a man of seventy or eighty, or a feeble old man of sixty, does not in my opinion demand surgery. Many of these patients suffer no greater inconvenience than that of being obliged to arise once or twice at night to urinate, the disease is very slowly progressive and they may safely be allowed to live out their allotted span. They should of course be watched, and any tendency to rapid progress of the trouble would demand surgical consideration.

Eighty-nine of my patients had infected bladders on admission. In 11 the urine was clear, free from pus, and sterile. This seems to have little if any bearing on operability—in fact, I think the infected cases are better risks. They have had time to vaccinate themselves against the gross infection which always occurs at operation. As a matter of fact, I believe all cases are infected before the enucleation is performed.

Renal casts were noted in 6 cases only. Fourteen patients presented a history of one or more attacks of hematuria; of these 3 proved to be malignant, while the others were benign. Of these latter 3 were admitted with the bladder distended with clots, demanding immediate cystotomy: in 2 of these a large intravesical prostate was noticed oozing blood from innumerable points, in the other case the exact source of bleeding was not definitely determined. Gross hematuria occurred only in the benign cases. Bladder calculi were noted in 5 cases; a small diverticulum not requiring any special attention, in 2 cases. In only 1 case was a large diverticulum, requiring excision, noted. This is rather interesting in connection with the problem of etiology of diverticula. If they are acquired, I wonder why they are not more frequently noted in prostatism? On the other hand I have operated upon 10 diverticula, in only 1 of which (the case occurring in this series) was there any evidence of obstruction to urination. This was a man of fifty-seven with a moderately large prostate and a history of twenty years' dysuria. It is interesting to note that while Wassermann tests were made on all these cases, that a positive Wassermann was noted in only two cases.

CYSTOSCOPY

Only 31 of these cases were cystoscoped. This sounds like rank heresy, but I do not believe in routine cystoscopy in all cases of prostatism. In my opinion it should be employed only to clear up doubtful points in diagnosis, and not as a routine procedure. Cystoscopy in many of these old men is much more formidable than cystotomy—and attended with more discomfort, greater shock, and greater risks.

Prostatic lesions noted with cystoscope:

	Number of cases
Moderate general enlargement	20
Slight enlargement of middle lobe	1
Pedunculated lobe	1
Median bar	1
Contracture of bladder neck	1

Rectal examination was of course made in all cases, and the following notes made:

	Number of cases
Marked enlargement	27
Moderate enlargement	50
Slight enlargement	11
No enlargement	5
Suspected carcinoma	3
Not noted	4

Frank carcinomas are not included in this series since they, in the majority of cases were treated with radium and not subjected to operation. Of the 3 cases in which carcinoma was suspected, 1 proved at operation to be malignant, the other 2 were not.

OPERABILITY

While I believe that the P. S. P. test is the most valuable single index, we have not relied upon it alone as a guide to our decision for or against operation, but have considered it rather in conjunction with other factors: blood chemistry, amount and specific gravity of the urine, and what I believe to be of great importance, the general tone and sense of well being of the patient. This latter includes a clean, moist tongue, a healthy grip, and a generally cheerful demeanor. It has seemed to me that the P. S. P. test is more nearly absolute in a positive than in a negative way. The high percentages, 60 per cent and over, have invariably proved to be good risks. A patient who has a moderately low phthalein output combined, as it sometimes is, with a good cardio-vascular apparatus and a reasonably good blood chemistry, is not necessarily a bad risk. Fifty cases in the group had a three hours' excretion of less than 50 per cent and 10 of these 50 had less than 40 per cent. All of these appeared like fair risks in every other way, and they made uneventful recoveries with no evidence of postoperative renal insufficiency. The lowest output recorded in an operated case was 25 per cent. This was in a man of sixty-six, admitted with complete retention and a zero phthalein. Under prolonged suprapubic drainage and other appropriate measures his phthalein rose to 25 per cent, and he appeared so much improved in other ways that we risked an operation, and he made an uneventful recovery.

'Phthalein output—three hours:

Under 40 per cent	10 cases
40 to 50 per cent	40 cases
50 to 60 per cent	20 cases
Over 60 per cent	27 cases
Not noted	3 cases
Highest output noted	83 per cent
Lowest output noted	25 per cent

The blood examination in all cases included a Wassermann and an estimate of red blood cell volume, urea, creatinin, sugar, and CO_2 combining power. The urea and creatinin content were considered of most general value in arriving at an estimate of operability, and the findings are noted below.

Urea Milligrams to 100 cc.	
Over 50	11
40 to 50	15
30 to 40	28
Under 30	36
Not noted	10

Creatinin Milligrams to 100 cc.	
Over 2	14
Under 2	83
Not noted	3

Roughly speaking, we considered cases with a urea of 50 or under and a creatinin of 2 or under as operable, provided that the cases with the higher reading did not present other unfavorable signs. One case was admitted with a blood urea of 213, reduced under treatment to 60, at which time he was operated upon and made a good recovery.

PREPARATION

All of our cases were submitted to preliminary drainage, and this I believe is the most important single item. I much prefer drainage with an indwelling catheter and a one-stage operation. However, the fact that the two-step method is a valuable help and has numerous definite indications is well shown in this series, 52 of which were done in one stage, and 48 in two.

Among the indications for the two-stage procedure are calculi, cases in which a soft rubber catheter cannot be passed or is poorly tolerated, and specially bad risks requiring prolonged preliminary drainage. The shortest period of preliminary drainage was three days (indwelling catheter). The longest, four months (suprapubic tube). The average was one week. During this time the laboratory work is done, fluids are forced, daily bladder irrigations are given, and urotropin and sodium benzoate administered. As a routine we give one dose of a mixed stock vaccine, feeling that this may be of some value as a bolster against infection. Cases with a low blood pressure are digitalized for two days preceding operation.

OPERATIVE PROCEDURE

Fluids are permitted and encouraged up to within one hour of the time the patient comes to the operating room, at which time $\frac{1}{6}$ grain of morphine is given by hypodermic, 20 ccm. of thromboplastin are given intramuscularly two hours before operation. Whether it be a preliminary cystotomy or a one-stage prostatectomy the bladder is always exposed and opened under local anesthesia, and gas-oxygen for the remainder of the operation. In 20 cases of this series ether was used by the following technique: The local anesthetic, and ether by the drip method on an open mask were started at the same time. At the time we were ready for the enucleation of the prostate the patient was under primary anesthesia: the enucleation was completed, and the balance of the operation done without further anesthesia. Usually about 3 ounces of ether were employed. There seemed less tendency to bleed, and in the main it seems a very satisfactory method. However, it requires a very skilful anesthetist and one who is working constantly with the operator. With the frequent changes of anesthetists occurring in most hospitals the method is not so practical. I believe for purposes of general standardization gas-oxygen is the anesthetic of choice. The enucleation is started intraurethrally as described by Squier, using two fingers of the left hand in the rectum as an aid.

The one point in operative technique requiring more attention than any other detail is the method of dealing with hemorrhage. The fact that this has been a fairly universal source of worry is well indicated by the number of methods which have been proposed for handling this problem. Personally I prefer and employ an iodoform gauze pack in the prostatic bed, reinforced if necessary by one or more additional packs in the bladder cavity. I feel that this acts in three ways: It stimulates contraction of the so-called prostatic capsule; it promotes clotting; and with a proper arrangement of the dressing exerts a certain amount of positive pressure. In my early cases it was my custom to employ a pack only in cases which showed at operation a tendency to bleed excessively (this was about 1 in 3 cases). In my later cases I have employed it as a routine, and since doing so have had no further worry about bleeding.[2]

The bladder is anchored to the aponeurosis with a chromic suture and the bladder wound is closed fairly snugly around the gauze packs; an iodoform gauze wick is placed in the prevesical space and the rest of the wound closed in the usual manner. No tubes of any kind are placed in the bladder at this time. The routine post-operative orders are as follows: Murphy drip 3 per cent calcium lactate, fluids by mouth as tolerated, hourly pulse, blood pressure every four hours, and change of dressings and morphine sulphate $\frac{1}{6}$ grain as required for pain or restlessness. A minimum daily fluid intake of 100 ounces is insisted upon for the first week—if not by mouth then by rectum or under the skin. This I believe to be the most important single item of postoperative care. The gauze packs are removed at the end of forty-eight hours, and a mushroom catheter is placed in the suprapubic opening. This remains in place from five to seven days, when it is removed and the wound is strapped. A 30 French sound is passed through the urethra on the tenth day. Patients are kept very quiet the first forty-eight hours. They are encouraged to move about in bed after that, and are usually out of bed on the fourth or fifth day.

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[2] Since writing this paper I have lost a patient from hemorrhage in spite of all precautions. This man had a great deal of pain, tenesmus, and strangury, which kept up a continual oozing with exacerbations accompanying each effort incidental to straining. He died in spite of repacking, transfusion, etc. I believe he might have been saved with more morphine and more packing.

The average stay in the hospital for this series was thirty-seven days. Excluding 3 cases which were in seventy-five days and 1 case, one hundred and five days, the average was thirty-two days. This I feel should be improved upon.

COMPLICATIONS

1. *Pre-operative.* There were 4 tight urethral strictures; 2 of these were treated by gradual dilatation before admission to the hospital, the other 2 by the same method during their preparation and convalescence. There were 3 cases of diabetes mellitus, one with a blood sugar of 400 mgm. to 100 cm. of blood. All of these made uneventful recoveries, and the wounds healed kindly. There were 4 cases of myocarditis with evidence of decompensation. They required careful handling but came through successfully. One case was admitted with complete retention and in uremic coma. He was sufficiently improved by drainage, at first with an indwelling catheter and later a suprapubic cystotomy with other appropriate measures, to permit a prostatectomy with a good recovery. There were 2 cases of epididymitis resulting from an indwelling catheter.

2. *Post-operative complications.* There were 5 cases of severe hemorrhage. None of this group was packed at the time of operation. Two of them proved fatal in spite of packing, transfusion, etc. There were 3 cases of acute pyelitis with more or less severe pyrexia. Forced fluids, stock vaccines, and alkalies (particularly potassium citrate) are indicated in this complication. Three patients (including one fatal case) gave evidence of post-operative uremia. In all of these the pre-operative phthalein was between 45 and 50 per cent.

Toxic psychosis. I rarely see this complication mentioned in the literature, and yet I find it a factor in not a few of my cases. There were 7 in this group severe enough to cause anxiety, and 1 of them died. These patients present a fairly definite clinical picture. They have a very slight elevation of temperature a moderate increase in the pulse rate, they are entirely irrational, they refuse fluids and nourishment, and often "want to go home."

This condition, if not corrected, may lead to gradual exhaustion and death. It is surprising how some of these patients are immediately improved by a change of environment, such as sending them home.

There were 2 pneumonias and 2 severe wound infections, 1 of them complicated by extravasation of urine deep in the pelvis, requiring an extensive groin incision for drainage.

There were 2 cases of severe and protracted hiccoughs, 1 of them lasting fourteen days with only an occasional short intermission. This was finally relieved by large doses of sodium bicarbonate, suggesting acidosis as the underlying cause.

There were 4 cases of epididymitis, each instance following the passage of a sound. There was 1 fatal case of pulmonary embolus, in which the diagnosis was confirmed by autopsy. This patient died suddenly on the twentieth day post-operative as he was getting ready to depart for his home.

There were 2 cases of marked delay in the closing of the wounds. In 1 of these there were several small prostatic nodules which had been left at the time of operation; these were readily enucleated through the open sinus, and was followed by prompt closing of the wound. In the other case we could ascertain no cause for the delayed healing. He left the hospital draining freely from his abdominal sinus and was lost trace of.

One very interesting case healed promptly, left the hospital on the eighteenth day post-operative with his wound entirely healed and voiding freely. A few days later he had acute retention which persisted. Cystoscopy revealed a membranous band stretched across the internal meatus; this was burned through with the high frequency spark and was followed by prompt and complete relief of the symptoms.

The mortality in this series was 5 per cent. Two patients died from hemorrhage. This is clearly an error in operative technique and should never occur. There was 1 death from uremia, 1 from exhaustion following toxic psychosis, and 1 from pulmonary embolus.

The pathological findings were as follows:

	Number of cases
Adenomatous hyperplasia	61
Fibrosis	4
Adenomatous hyperplasia and fibrosis	8
Prostatistis and fibrosis	8
Carcinoma	10
Myoma	1
Not noted	8

Of the 10 cases of carcinoma one was suspected before operation, 2 others while not suspected before operation were clearly evident at operation. The remaining 7 cases were demonstrated only after careful sections and laboratory study. Clinically I believe that many of these in the last group are relatively benign.

There was 1 case of pure myoma, the only case of the kind that has ever come under my observation. A casual survey of the literature leads me to believe that they are either very rare or very rarely reported. The clinical points of interest are that it occurred in a relatively young man (fifty) with a short history (two months), the prostate was very large, and very free bleeding attended its removal.

In conclusion, this paper is presented with the hope that it may promote discussion which will perhaps add some small item to the further development and standardization of this very important procedure.

PROSTATECTOMY UNDER LOCAL ANESTHESIA[1]

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There is no doubt that general anesthesia is one of the most prolific contributors to the mortality of prostatectomy. Its injurious influence is shown not only in the after-shock, often ensuing on the administration of a general anesthetic, but also made evident in other agencies of destruction, such as dilated stomach, paralysis of the bowel, myocarditis, suppression of urine, uremia, acidosis, etc., that usher in the lethal ending.

It is a further fact that these unfortunate conditions often arise most unexpectedly and even in the face of favorable returns from physical examinations and laboratory tests of body functions. They can neither be always foreseen nor prevented. Cases apparently progressing most favorably may suddenly change and succumb to such influences—multifarious, but usually ascribable to the effect of the general anesthesia.

The result has been that we have adopted the plan of carrying our prostatectomy patients through the operative stages without any form of general anesthesia—and we have been much gratified with the results of the change. The old fellows go through with practically no suffering, although most of them are conscious and quite capable of expressing themselves on the subject of pain or discomfort. They are free from subsequent shock and depression, nausea, vomiting and other gastric disturbances; and can resume their normal ingestion of foods and drink with vastly greater promptitude.

From every standpoint the post-operative conditions are more satisfactory.

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[1] Read at the meeting of the American Urological Association at Rochester, Minn., May 21, 22 and 23, 1923.

Our plan of procedure is the following:

The patient arrives at the operative stage after having been prepared in every possible way by cardiac regulation, alkaline proctoclysis, systematic urine drainage through a retained urethral catheter, gradually established, in place of the chronic urinary retention that may have been of five or ten years' duration. The patient is assumed to be in as good a condition of health, both locally and generally, as he can be made before operation. To further promote safety and assure success, the operation is done in two stages: The first stage for opening and draining the bladder suprapubically; the second for removal of the prostate.

A mild laxative is given the night before the operation and an enema if necessary early the next morning. One hour before the time for operation an ampule containing $\frac{1}{130}$ grain of hyoscine hydrobromide, together with $\frac{1}{6}$ grain of morphine, is given hypodermically. If shortly before the time for operation (fifteen or twenty minutes) the patient is not becoming somewhat soporific, another $\frac{1}{130}$ grain of hyoscine is given hypodermically. The suprapubic skin, muscles and pre-vesical tissues are then thoroughly infiltrated after the method of Schleich, with 0.5 per cent solution of novocain. This permits the making of a suprapubic incision about 3 inches long, through skin, muscles and anterior bladder wall—the infiltration of each stratun preceding the cutting. A good sized elbow tube is placed through the suprapubic incision into the bladder, the wound is closed around the tube, the urethral catheter is removed and drainage is then carried on via the elbow tube until the second stage of the operation is done, one or two weeks later, according to the progress and condition of the patient.

The preliminary one or two hypodermics of hyoscine hydrobromide (and one of morphine) are given as before, at periods of one hour, and of fifteen minutes before the operation.

In addition, sacral anesthesia is administered fifteen minutes before operating.

Much time and thought have been expended on the strength of novocain solution employed in sacral anesthesia. Without going into a discussion of the subject, we believe that the anesthesia should depend on the *pressure* effect rather than the drug effect: that a larger quantity of a weaker solution of novocain is likely to be less toxic but equally as effective. We have therefore adopted the following formula, using only half the strength of novocain given by Scholl.[2]

Powder 1: Sodium chlorid. 0.10 gram
Sodium bicarbonat. 0.15
Powder 2: Novocain 0.30

Mix these two powders and add to 30 cc. of freshly boiled distilled water, making 1 per cent solution of novocain. From 30 to 60 cc. of this strength may be given with safety, care being taken to avoid infiltration into tissues outside of the sacral canal.

The patient lies on his side, with knees and thighs strongly flexed on the abdomen, while the injection is made through the sacral hiatus into the sacral canal (not the spinal canal). On completing the injection the patient sits upright on the table for five minutes, then lies flat on his back, in a semi-Trendelenburg posture. The suprapubic tissues are again infiltrated sufficiently to permit the re-opening of the wound, giving free access to the bladder and permitting a complete palpation of the obstructing conditions.

An assistant inserts the prostatic elevator of Lewis into the rectum and brings the prostate well up to the operator's right forefinger (left or right, according to preference of operator) which carries out the enucleation in the usual way. The elevator is held either by the operator or an assistant, although it is preferable to some operators to hold it themselves, as it keeps them in closer touch with the situation.

The infiltration process provides anesthesia for the pre-vesical structures, while the sacral injection provides anesthesia for prostate and bladder. If it should happen that the prostate is not quite sufficiently anesthetized, infiltration under its sheath may be effected through a long needle working through the upper wound.

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[2] A. J. Scholl: Jour. Urol., August, 1921, vi, 149.
H. Eyner: Centralbl. f. Gynak., January 15, 1921, xlv, 50.

In some cases in which the patients grunted occasionally as though in moderate pain, they have declared later that they did not recall any actual suffering and some did not know just when the removal was being done. The caudal injection should anesthetize the urethra, anus and adjacent structures, as well as the bladder and prostate; providing for the comfortable introduction of the Hagner bag or other means of hemostasis, or urethral or suprapubic drainage tubes, etc.[3]

While general anesthesia has a direct and indirect mortality that is recognized, and spinal anesthesia one that is awe-inspiring, the various methods and forms of local anesthesia do not have a serious stigma attached to them in this respect.

It was said a few years ago that caudal anesthesia had no direct mortality, but some few instances have been reported in which this method could not be held free of blame for the fatal results.

In reviewing the mortality of sacral anesthesia, Zweifel,[4] has found 3 cases in 1400 apparently due directly to the use of this method: One (of Schweitzer) in which the dural sac extended abnormally low and the needle penetrated into the spinal canal, into which the injection was made, death following almost immediately. The second case was that of Irle, death occurring in seven minutes after the injection was made, an injury to the dural sac being established at autopsy. The third, a case of Liebich, in which death occurred in ten minutes after injection, tuberculous peritonitis and a low condition of vitality being present. Acute novocain poisoning in each case was supposed to be the causative agent of death. These occurred in a collection of 1400 cases, giving 0.02 per cent mortality. The dose given in the first two instances was 0.80 gram, and in the third,

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[3] After having used the prostatic elevator of Lewis, it is advisable before sewing up to insert a double-gloved finger in the rectum for a final determination by bi-manual palpation as to whether any remaining prostatic tissue requires removal.

[4] E. Zweifel: Deutsche Ztschr. f. Chir., 1920, cliv, 338.

Lewis and Bartels: Surg., Gyn., and Obs., March, 1916, 262–268.

0.90 gram. It is evident that in addition to the wounding or penetration of the dural sac, too large a dosage was given in each case. The author considers 0.50 gram novocain a safe dose, as there has been no record of casualty with that dose or less. Meeker and Frazer of the Mayo Clinic report 225 cases of pelvic operations without a death. And they assert that complications and after effects have been few and of no serious concern.

After introducing the needle into the sacral canal, the obturator is always withdrawn and observation made with reference to escape of fluid or blood. Neither of these should appear; and if they do, it demands the withdrawal of the needle an inch or so back into the sacral canal, which should give issue to neither blood nor serum in any amount.

Illustrating the advantages and safety of local anesthesia in this work, a few brief notes of some cases are submitted, as follows:

R. N. D., of Kingsland, Ark., age sixty-five, referred by Dr. J. C Minor, of Hot Springs, Ark.

Patient entered the hospital December 12, 1921, on a stretcher. A month previously he had had a bilateral hernia successfully corrected in a hospital in Arkansas. However, the patient had not been able to empty his bladder following this operation. There was a residuum of from 12 to 15 ounces of infected urine. A marked cyanosis had existed for eight years which had not been accounted for. Examination of the blood showed methemoglobin and explained the condition—enterogenous cyanosis. The patient was so extremely weak that he could not turn himself in bed. A marked diarrhea of two weeks' duration persisted ten days before coming under control. The laboratory findings were as follows: Non-protein nitrogen, 28.5 mgm., blood urea, 15 mgm.; creatinin, 1.5 mgm., phthalein, 12 and 10 per cent for two hours, hemoglobin 70 per cent, blood pressure, systolic 180, diastolic 100. A retained catheter was installed, affording interrupted drainage at first, until the internal bladder pressure had been gradually reduced and continuous drainage safely provided,[5] after which the thalein output was increased to 15 and 20 per cent for the two hour period. Cystoscopic examination showed a large bilateral encroachment of the prostate. Meanwhile an attack of epididymitis (left) intervened, which delayed measures for two weeks. After this a period of furunculosis prevailed to a severe degree, one focus on the back resulting in an extensive carbuncle that required free incisions and threatened the life of the patient.

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[5] For description of this method see: "Prostatectomy, with its preparatory and post-operative treatment," by Bransford Lewis; Trans. So. Surg. Assoc., 1918.

Finally the patient seemed in a fair condition for operation. A cystotomy was done under local anesthesia, March 21, 1922 Following this favorable progress was made and the second stage prostatectomy was done April 3, 1922, using sacral and infiltration anesthesia The patient made a good recovery and left the hospital May 10, 1922, in excellent condition He is well and healthy today. The fact that this patient was safely carried through a prostatectomy despite the menacing complications that arose, one after another, is good evidence that a man gets neither too old or too weak for consideration of this procedure, provided the required precautions and preparations are carried out.

J. W. S., of Excelsior Springs, Mo., aged sixty-one, referred by Dr. Ernest Lowery of Excelsior Springs, Mo., entered the hospital October 25, 1921, in a semi-uremic condition. Attempts by his family physician to catheterize the bladder had not been successful for a two day period preceding this. The patient was in extreme pain which was considerably relieved when we were able to catheterize and establish interrupted drainage, as previously described. The uremic stupor soon improved but a mental torpidity persisted at intervals throughout his stay in the hospital. It seemed that this patient was particularly prone to acidosis and alkalis were constantly pushed to carry him to even a fair operative risk. Cystoscopic examination showed a bilobar enlargement of the prostate which accounted for 15 ounces of residum urine. The laboratory findings were: phthalein, 20 per cent for first hour, 35 per cent second hour, *hemoglobin 55 per cent, non-protein nitrogen, 60 mgm; blood urea,* 29 mgm., *creatinin 2.95 mgm. blood pressure, systolic 230, diastolic 115.* Under the treatment mentioned above the general condition of the patient was decidedly improved and the laboratory findings on November 4 were: non-protein nitrogen, 38 mgm., blood urea, 17 mgm.; creatinin, 1 mgm. The phthalein output was 25 and 35 per cent for two hours. The blood pressure was, systolic 190, diastolic 108. On November 14 a cystotomy was done under local anesthesia. An HMC tablet was given forty-five minutes previous to operation. The operation was without incident. Two days later, however, the patient went into a uremic stupor without warning and vigorous measures (intravenous sodium bicarbonate 3 per cent and glucose 2 per cent; 5 per cent sodium bicarbonate proctoclysis, electric hot packs and heat stimulants) were required to carry him through. Body functions reacted favorably to this treatment and the patient was soon stabilized and able to go to his home for a rest, a suprapubic drain tube in place, meantime. On November 2, the patient returned, and after waiting a week the second stage was done, using sacral and infiltration anesthesia in the usual way. An HMC tablet was given forty-five minutes before the operation. Other than a considerable loss of blood, the operation was without incident. A slow but uneventful recovery was made and the patient was discharged well on April 21, 1922. A recent report states that he is in good health today.

I. D., of Fayette, Mo., aged seventy-two, referred by Dr. C. H. Lee, of Fayette, Mo., entered the hospital February 20, 1923, showing unmistakable signs of uremia and cardiac weakness. Twenty ounces of residual urine were found. Cystoscopic examination showed a large intravesical prostatic hypertrophy. Laboratory findings were as follows red cells, 4,900,000; white cells, 9800; hemoglobin, 85 per cent; clotting time five minutes; blood pressure 210:115; *non-protein nitrogen, 47 mgm.; creatinin 2.5 mgm.* The phthalein output was 2.5 and 10 per cent for a two hour period. Retained catheter drainage was instituted and sodium bicarbonate in large amounts was given by mouth, proctoclysis, and on three occasions 900 cc. of the fluid (5 per cent) intravenously. Meanwhile the patient was in an extremely precarious condition. The pulse was weak, irregular and intermittent; the extremities cold. Recovery seemed very much in doubt. However, with continued pushing of alkalis, heart stimulants, electric hot packs and efficient drainage there was a gradual recovery. On March 3, 1923, the non-protein nitrogen was 42 mgm. and the phthalein 10 per cent for the first hour and 12 per cent for the second. A cystotomy was done subsequently, the patient being given $\frac{1}{130}$ grain hyoscin hydrobromide and $\frac{1}{6}$ grain morphine sulphate forty-five minutes previously. Infiltration anesthesia (0.5 per cent novocain) was used in the abdominal wall. The patient suffered no ill effects from this operation and was considered to be in his best possible condition for completing the operation a week later. After a preliminary hypodermic injection of $\frac{1}{130}$ grain of hyoscin hydrobromide and $\frac{1}{6}$ grain of morphine sulphate at 7:00 a.m. sacral anesthesia was administered at 7:45 a.m. The sacral hiatus was located with difficulty and a certain amount of infiltration of the novocain solution into the tissues resulted. Ten minutes later the patient collapsed suddenly, the pulse became imperceptible and soon heart sounds could not be heard with a stethoscope. The ordinary stimulants including oxygen inhalations and artificial respiration did not revive him. To all appearances the patient was dead. Then a more radical measure was resorted to, namely the injecting of 10 cc. of a 1:1000 adrenalin chloride solution into the heart muscle (ventricle) as described by Dennis W. Crile.[6] The response was immediate and recovery was shortly thereafter complete. The blood pressure was 200 systolic and 115 diastolic about two minutes after the solution was injected. However, the patient was put to bed and given a week's rest at the end of which time the prostatectomy was completed, using the same anesthesia as at the previously attempted operation.

At this time, however, there was apparently no infiltration of the novocain solution. Carcinoma of the prostate was recognized at the operation, which was confirmed by the pathologist. A week later 50 mgm. of radium in a silver capsule was placed in the prostatic cavity for eight hours. Severe cough, expectoration of dark and at times bright red blood, led to the suspicion of metastasis into the lungs. Chest X-ray plates showed marked clouding at both hiatus regions, particularly the left. Plates of the spine and pelvis showed distinct metastasis into those regions. Because of these latter findings further attempts to combat the carcinomatous processes were abandoned. However, the patient made a rapid recovery from the operation and was able to leave the hospital three weeks later with urinary functions completely and satisfactorily established.

[6] D. W. Crile: Surg., Gyn., and Obs., December, 1922.

THE TREATMENT OF URETHRAL STRICTURE BY EXCISION[1]

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This important subject is given very scant attention in the text books of general surgery and not much more by the authors writing upon the speciality of urology.

Resection of strictures as a surgical procedure of effecting a relative cure, of permanent duration, has never gained great popularity with the surgical world, chiefly because of lack of accurate knowledge of the anatomy of the urethra and the perineum, and of the ever present fear that the removal of any portion of the corpus spongiosum will result in lasting mutilation with prevention of erection, and impotence. There has also been a natural apprehension that after the removal of sections of the canal of considerable extent, there might result a necrosis of the approximated cut ends. For these reasons, reports of resections have usually been confined to the results obtained from the removal of the two sides and the bottom of the tube, and the nodules infiltrating the spongy body and the adjacent tissues, leaving a strip of mucosa, frequently a very narrow one, from which the epithelial lining of the new tube is to be proliferated. A better understanding of the remarkable distribution of the blood supply to the urethra lavishly furnished from the bulbous, cavernous and dorsal branches from the internal pudic arteries by anterior as well as posterior anastomosis;—a knowledge that the tube can be mobilized to almost its entire extent without risk of necrosis; and an acquaintance with the muscles attached to the scroto-perineal portion of the urethra, makes urethrectomy in certain types of stricture a procedure of choice, which I am ready to advocate and demonstrate in this paper.

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[1] Read at the meeting of the American Urological Association, Rochester, Minn. May 21, 22 and 23, 1923.

The trail of the history of this operation, like that of so many of the procedures of modern surgery upon pelvic and perineal organs, leads directly to the amphitheatre of an American teacher, Dugas, who first reported a case of complete resection of the urethra without any attempt to bring the cut ends together, in the Southern Journal in 1836. From time to time in France, Germany, England, Switzerland and America, during the last hundred years occasionally a report of partial or complete urethrotomy, usually partial, has appeared in the professional journals, but without creating any stir or wide spread emulation.

The first to practise sutures of the separated ends was Heusner in 1882 but much more ingenuity has been shown in the repeated efforts to supply a mucosa for the tube between these ends by grafts from the skin of the perineum, scrotum or prepuce, a pedicle flap of dartos, fascial grafts, Thiesch grafts supplied from the mucosa of a prolapsed uterus, transplanted bodily; or the insertion of tubular grafts derived from large veins of other mammals, or of the appendical tube sutured in place over a catheter. With any one or all of these, at times, results more or less successful are obtained, temporarily satisfactory, at least to the surgeons using them. During the last century, the only surgeon, who adopted urethrectomy as a method of choice in the treatment of severe strictures of the urethra was König, in whose clinic the rule was, for a time at least, to submit all of such cases to resection where the mucosa of the urethra had lost its characteristics as a mucous membrane, and the resected ends of the tube could be brought together. He reported some very interesting results but apparently failed to realize the advantages afforded in the operation by the extreme mobility of the urethra. Resection has been also extensively practised at the Necker Hospital by Guyon and his eleves Albarran, Legueu and Marion, but confined to cases which permit the retention of a continuous mucosa and is applicable only to cases not requiring the loss of more than 2.5 to 3 cm. on the sides and floor of the canal. A very satisfactory technique worked out by this school for the repair of such a partial resection is figured in the third edition of Greene and Brooks P 452–453. A second operation devised for the same purpose and applicable only to very narrow and incomplete strictures at the junction of the membranous and bulbar portions of the canal is that of Maximilian Stern, described in the Journal of American Medical Association, 'January, 1920, ingenious in its conception, and surgical in its execution it is meant to deal with cases in which there is no cicatricial destruction of the corpus spongiosum.

For the radical removal of all of the strictures from face to face, antero-posteriorly, together with the entire spongy body within these limits, use may be made of: (1) the Albarran technique; (2) the technique of Hamilton Russel of Melbourne; (3) the technique of MacGowan which is here described and which I developed during my years of active service in the Los Angeles County Hospital, and have since applied from time to time in my private practice with most gratifying results. In any of these operations whether the incomplete resections of the Necker school or of Sterns, or the radical procedures of Albarran, Russel or MacGowan a satisfactory field for the operation is only to be obtained by having the patient in an exaggerated lithotomy position, using an inverted "Y" incision for the obtaining of a complete exposure of the musculature of the perineum and the scroto-perineal urethra, so that the entire structure of the corpus spongiosum from the urogenital diaphragm to a point as far forward in the phallic urethra as may be found necessary is laid bare, and so separated from its attached structures, that the diseased and strictured portion may be freely removed in its entirety, and the parts of the tube beyond these limits mobilized so completely that they may be united by suture without tension. In the presence of a case deemed suitable for this radical procedure, a preceding suprapubic drainage should be instituted and maintained for a time sufficient to demonstrate whether, as so often happens, the infiltration in the tissue, about the urethra, relieved of the continuous irritating influence of the decomposed urine may not gradually soften and disappear to the extent that the stricture deemed impassable readily becomes easily amenable to dilation. If after two weeks or thereabouts, this change does not take place, resection of the stricture becomes the procedure of choice. Preparation for the exposure of the stricture should include the having at hand of a number of delicate sharp knives, both for incision and dissection, small sharp scissors, straight and curved, delicate needles, sharp and round pointed, which will hold no. 0 chromic catgut, fine pure silver lachrymal probes, a dozen fine straight and curved artery forceps; in fact the instruments necessary are those which should be found in the kit of an eye surgeon. In addition one requires a fine grooved director, a small straight gorget, a Wheelhouse staff, to cut upon for opening the urethra anterior to the stricture if no filiform can be passed as a guide, and a Gouley tunneled staff of silver no. 8 or 10, if a filiform can be made to penetrate the stricture, a retrograde staff upon which to open the urethra behind the stricture and the usual bifid and other retractors necessary in exposing the apex of the prostate as in Young's perineal prostatectomy.

I know of nothing in surgery that is quite so disgusting as to see an operator, messing at a stricture with unsuitable and inadequate tools, destroying whatever favorable chances the subject may have of recovery from his terrible disease, by clownish gestures. If no filiform or guide may be made to penetrate the stricture, its remaining mucous channel may be mapped out by staining its course with the solution of a dye, injected under pressure through the urethra. For more than thirty-five years, in the Los Angeles County Hospital, I have used methylene blue for this purpose, for which I claim no priority, as I think I got the idea from my teacher Professor Robert Ultzmann in Vienna.

The preliminary dissection finished, the central tendon of the perineum severed close to the bulb, and the anterior layer of the triangular ligament well exposed, the ischiocavernous muscles should be pushed aside, the bulbocavernous tendon split along the white line at its center to the point where it joins the insertion of the tendons of the superficial tranverse perineal muscles at the root of the bulb, which are to be clamped and severed close to their insertion into the spongy body, exposing the urethra, then easily freed from its facial and muscular coverings and its attachments to the cavernous bodies, chiefly by blunt dissection with gauze, straight scissors and knife handle, as far forward and backward as required to get past the limits of obstruction and expose healthy mucosa in opening the canal. These steps should be conducted with patience and gentleness for it is essential to do no gross damage to the arterial or nerve supply. If a filiform guide can be passed, the urethra can be opened in the strictured portion upon the Gouley catheter staff which has been threaded on it and its course followed anteriorly and posteriorly until healthy elastic mucosa is encountered. If no guide can be introduced, a small quantity of a solution of methylene blue may be injected down the canal under moderate pressure and the canal opened directly in front of the palpable limits of the stricture upon a Wheelhouse staff, when, after the introduction of two traction sutures, through the entire urethral walls on each side, including the mucosa, by the aid of a good light, the sclerosed and contracted canal may be searched for by fine silver probes, gently and patiently, following the stained epithelium and with sharp fine knives and scissors gradually laid bare to its posterior limits. If the track of the stricture is lost or appears to be totally obliterated, the urethra is to be opened upon a retrograde staff in front of the anterior layer of the triangular ligament and as close to the stricture as possible, the traction sutures inserted in the urethral walls and the search for the canal conducted forward with the silver probe, filiforms or silk bougies. Found and laid open from one extremity to the other, we are then ready to resect. Whether the procedure adopted be that of Albarran, applicable only to contractures in the tube not exceeding 2.5 cm. in length or that of Russel, or that of MacGowan in which the only limit is that in which the two ends may be brought together by sutures without excessive tension, and which has actually in experience amounted to as much as 8 to 9 cm. The line for excision must be made in healthy mucosa and beyond the sclerosed infiltration of the spongy body in which the urethra lies; thus severed, fore and aft, the sclerosed canal with its portion of the cavernous body and the surrounding inodular tissue is to be dissected out from its bed in its entirety, avoiding injury to the corpora cavernosa and to the internal pudic artery and its larger branches. Ordinarily the hemorrhage will be only moderate for the inflammatory changes long continued, have so cicatrized the reticulated normal structure of the bulb that its spongy nature is lost. In removing the fleshy slap from beneath the arch of the pubes, one should bear in mind the close proximity of the plexus of Santorini.

The section of the tube removed, the appearance of the structures in the perineal field is not encouraging, but because of the great elasticity of the urethra, its great mobility and its rich blood supply, marvels can be accomplished in its repair, by either the Russell procedure or that of MacGowan. In the operation of Russell, in which the primary incisions into the healthy canal have been made, both anteriorly and posteriorly a considerable distance away from the face of the stricture, after the excision, a flat strip of mucous membrane is left in the field, which he proceeds to extend and enlarge by slitting the canal further on its ventral surface and undercutting both strips of the ribband until enough is mobilized so that the two squarely cut ends can be sewed together without tension by fine catgut sutures passed so that the knots are tied on the mucosa. The surface of the wound is protected from urinary contact by means of a catheter inserted through the membranous urethra at the apex of the prostate and the reconstruction of the canal left to itself, depending upon the fact that on account of the peculiar structure of the perineum, the sides of the urethra will roll in and eventually resume its normal tubular form, if a continuous mucosa is secured on its dorsal aspect and contamination or infection by urine be not permitted during the first few days following operation.

In the MacGowan operation, the intention is to restore the tube by approximating its cut ends in their entire circumference and we find this is best achieved not by the laying of a circular stitch, such as was done by Mayo Robson with success after the excision of an annular stricture, where the loss of stricture was not more than one quarter of an inch and as was the practice of König but by slitting the urethra and spongy body both anteriorly and posteriorly into three strips, or ribbands, one posterior and two lateral, using great care not to mangle the tissues and to have clean incisions; for this purpose, one must have very sharp, straight eye scissors. The length of these ribbands will vary with the necessities of the case, but they must be long enough to permit the placing in the posterior one, of the three sutures of no. 0 chromic catgut, which has been soaked in hot salt solution previously to render it flexible, and each threaded on two fine, sharp needles and inserted about 1 cm. from the cut edge of the tube, passed from within, out, and tied with the knots outside the lumen of the canal, the central first. Before the knots are tied, the cut edges are to be approximated by means of traction sutures of silk inserted in the mobilized ends of the urethral body just beyond those parts which have been converted into the ribbands. If they do not join easily under moderate traction, the tube may be mobilized still further, if necessary, the skin slit being extended as far as the frenum, and the spongy body pried out of its bed, where it lies mortised between the corporae cavernosa, and the posterior segment of the tube may be loosened by careful blunt dissection, after the attachments of the superficial transverse perineal muscles to the bulb have been severed, as far as the anterior layer of the triangular ligament. When it is found that the cut edges can be brought together by moderate traction, both sections of the tube are then anchored in this position to the bed from which the cicatrized urethral tissues have been removed, by means of sutures of no. 0 chromic gut, previously softened, using new, round pointed needles of appropriate size. These stay sutures must be inserted into firm tissues; they always penetrate the sheath of the spongy body and may, if necessary, be inserted into, but not through, the sheaths of the cavernous bodies. As many of these sutures may be employed as may, in the judgment of the operator be necessary to retain the urethra in its new position and effectively prevent any strain being made upon the line of suture of the ribbands. The three sutures in the dorsal ribband having been tied, a soft rubber catheter is passed from the meatus to the triangular ligament and secured there by one suture of no. 1 plain catgut so that it may not be displaced accidentally or intentionally before the fifth or sixth day, and then the lateral ribbands sewn together in a like manner, first from end to end with no. 00 chromic gut and then united from side to side by one or more fine sutures of plain gut, after which the disturbed and separated bulbo-urethral muscles are replaced, the cut ends of the transverse perineal muscles repaired and the ischio-cavernous muscles which have been retracted, brought forward and attached, by a few plain catgut sutures to the bulbo cavernous muscle mass, to better cover the deep perineal nerves and arteries and the base of the cavernous bodies. The cellular tissues lying between the skin and the muscle mass of the urethra are repaired and brought together by a few plain catgut sutures so as to obliterate all dead spaces. The skin is repaired with black silk or fine flexible silk worm sutures, but no attempt is to be made to completely close the perineal wound unless the surgeon desires to lose his time and jeopardize the welfare of his patient. The foes that may prevent success are hematoma and infection; neither will occur if a cigarette drain is kept in contact with the surface of the point of excision for a few days, and there need be no hurry about removing it, for oozing serum, liquifying catgut, and staphylococci in a perineal wound make a bad combination, especially in the presence of accidental soiling by infected urine, if drainage is interfered with. So important is this, that I am convinced that the interests of the patient would be better conserved if the entire perineal wound were left open and packed than if an attempt were made to close it without drainage. Before the ends of the canal are united, the membranous and prostatic urethra should be carefully examined for stenosis. If a stricture is found in the membranous urethra, it should be severed by a Blizzard knife. If contracture of the bladder neck exists, it should be dealt with by the MacGowan-Parker punch. Where the excised section of the tube has been very long, when united, it will be noticed that there may be considerable ventral curvature of the penis. This need cause no anxiety; time will restore it to its natural shape. The catheter retained in the canal, I have always kept in place for from six to ten days (this precaution is not taken to assist the uniting of the ends of the ribbands, but to prevent the accidental adhesion of the granulations in the line of union that may not be perfectly covered with the mucosa). Perhaps the wounded surfaces would unite and a tube be formed just as well without it, but my ultimate results have been exceptionally good and I desire to take no chance. There is often considerable oozing from the wound for the first twenty-four hours, hence I prefer to use large dressings of plain gauze, moistened with normal salt or Thiersch solution applied hot and changed frequently and kept against the perineal wound surface under pressure; subsequently I prefer the dressings next to the skin be plain gauze dipped in melted vaseline, which so fills the meshes that the dressings will not adhere. The urethral surfaces may unite perfectly and the wound close in two weeks, but this is not to be expected. At the end of the second week, the suprapubic de Pezzer drain is dispensed with, then, usually, the supra pubic wound closes in a few days and normal urination is established. If a fistula persists in the perineum, after the third week, it is probably due to the irritation of an unliquified and unabsorbed piece of the chromic gut, and one must wait until the knot is loosened and comes away of itself. A sound, not a large one, say, 18 or 20 F., may be cautiously passed on the fourteenth day and then at intervals of a week in gradually increasing caliber, but no attempt made to enter sounds that put the canal on a stretch or distend it; the game is to secure a canal that will be permanent and allow the individual to pass urine easily, and the use of any violence to the line of sutures may easily produce a rupture of the urethral tissues and defeat the project. If sounds do not pass easily, but the patient voids a full comfortable stream, the operator should not worry; the canal probably has a kink in a part of the line of healing and the channel is not absolutely straightly continuous. The patient should be let alone, so far as he is concerned, the cure is a satisfactory one. It is very hard to get perfect follow up histories upon difficult stricture cases, especially upon those operated in public institutions; relieved and elated, they hide out, and receive no treatment until the stream again becomes slow, small, or retention takes place. Many of these upon whom I have done urethral resections disappeared entirely within a few weeks or a few months, but there were no positive failures. One of my earliest cases, operated upon about twenty-five years ago, after an interval of approximately twenty years reported that he had never had any more trouble after I "cut his strictures out." I have now, several under observation, who have been operated upon of recent years, one whom I had the opportunity to examine the canal with the cysto-urethrascope and through the urethrascopic tube, after the perfect healing of the wound, whose history and testimony of results obtained follows. This man's evidence comes three years after a complete resection of more than 6 cm. of the bulbar urethra and is that he is sexually potent and in the vernacular of the hour "just fine."

I. G., forty-three years old, carpenter, resident of Pine Knot, California, referred to me by Dr. Howard Hill of Redlands, December 31, 1919.

On October 13, 1919, he fell astride a floor beam at the camp where he was working and ruptured his urethra. The ends were found by Dr. Hill and with considerable difficulty a no. 15 soft rubber catheter was passed from the meatus to the bladder, the wound in the urethra repaired and the external incision closed with drainage. After thirteen days, the catheter was removed; when urinating the patient passed a good stream but no instrument larger than a no. 10 F, could be inserted to the bladder. On November 19 he had an attack of retention of urine; under incomplete anesthesia, sounds were passed following which he voided freely until November 27, when he had retention again, which relaxed under heat and morphine. From then until he came to me on December 31, he passed his urine in a thin small stream without pain.

A hard infiltration was felt at the site of the rupture in the urethra; the prostate was smooth and normal in size. Under local anesthesia, we passed a filiform and over this, threaded a no. 8 silver Gouley staff catheter, through which the bladder was emptied and the filiform tied in. By continuous dilatation with filiforms and silk bougies until January 8, 1920, we secured a canal that would admit the passage of a no. 18 cystoscope. An examination of the bladder showed edema and congestion of the trigone, the usual small hemorrhagic spots from the presence of the bougies, some very fine gravel and a marked trabeculation of the mucosa which did not disappear upon distention. The mucosa of the posterior urethra was abraded and edematous. Examination of the anterior urethra with a no. 22 Koch urethrascope demonstrated a circular stricture of the perineal urethra with no normal mucous membrane about it. The patient was informed that resection of his urethra was necessary and having given his consent thereto, a preliminary suprapublic cystotomy was done on January 10. On January 13, we resected a little more than 6 cm. of the bulbar urethra, removing it in its entirety, floor, roof and sides as well as dissecting out all of the surrounding scar tissue, that had resulted from the rupture of October 13. In the removal of the stricture and the restoration of the canal, we used my own method which is the subject of this report. On January 27, the suprapublic de Pezzer drain, found to be sanded, was removed and replaced by a new one, which was retained until February 4. On January 29, I passed a no. 19 F. steel sound with ease and followed it with a no. 18 soft rubber catheter so as to irrigate the bladder and the urinary tract from below. March 1, we found a small abscess in the tissues of the perineum which did not communicate with the urethra; this was drained and gave us no further trouble. On February 5 he was passing one-third of his urine by the meatus. On February 20 all of the urine came by way of the meatus. On February 20, the wound of the skin was treated and a no. 27 F. steel sound passed without any obstruction. He was kept under observation until April 1. At that time a no. 28 F. steel sound entered the bladder by its own weight; he passed a full and copious stream without dribbling at the finish, at normal intervals. By the cysto-urethrascope and the open urethrascope we could detect no definite scar tissue. The case was dismissed.

I have heard from this man twice since, first in March, 1921, without my solicitation; second on April 25, 1923, in reply to a follow-up letter. Both letters follow and show that total resection of the bulbo-perineal spongy body for stricture are feasible without danger of loss of sexual potency and with the result of a permanent cure of the strictures.

Pine Knot, California.
2/7/21.

Dr. Granville MacGowan,
Los Angeles, California.

Dear Sir:

Probably you have forgotten my case, but I thought probably you would like to know how I came out. If you remember, you operated on me January 8, 1920, for stricture caused from injury. I am all fine; have had no trouble whatever in any way. I have been in snow and was dragged through snow and water by a runaway team and got soaked good; was out about three hours before I could get dry clothes. I eat and sleep good; weigh 172 pounds. I have been very careful about lifting and have had no indications of retraction; no trouble urinating; no pain or weakness from the parts operated on. Should you desire any additional information regarding my case, I will be glad to give the same to you at any and all times.

(Signed) Joseph N. Graham,
Pine Knot, Calif.

Pine Knot, California.
4/25/23.

Dr. Granville MacGowan,
Los Angeles, Calif.

Dear Sir:

Your letter of recent date received and contents carefully noted. In reply to your inquiry regarding my present physical condition, I pass a good large stream free from any annoyance of any kind; have been wet several times and no indications of contraction, no irritation of the bladder. As to sexual intercourse am O.K. absolutely no trouble of any description; good appetite, weigh 170. Thankfully say I am as good as I was before the accident except weakened condition caused from the flu I had last February but as to my trouble (that is my operation) can say in A No. 1 shape.

Very sincerely,

(Signed) J. F. Graham,
Pine Knot, Calif.

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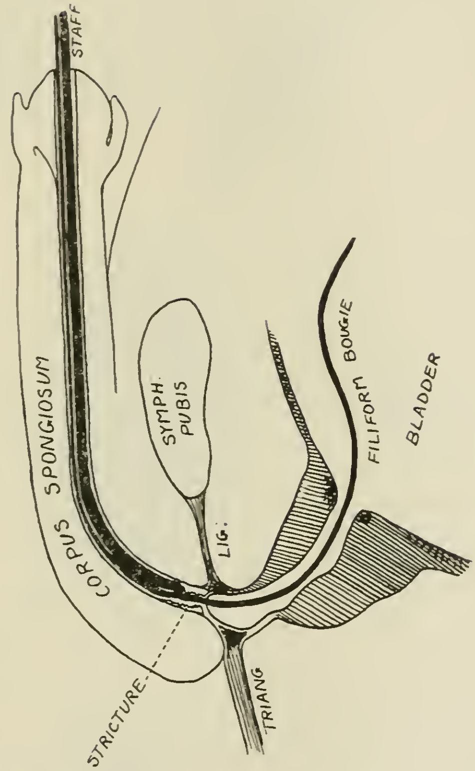

Fig. 1. Reproduced from Maxmillian Stern. Illustrating Common Position of Strictures Requiring Resection (Schematic)

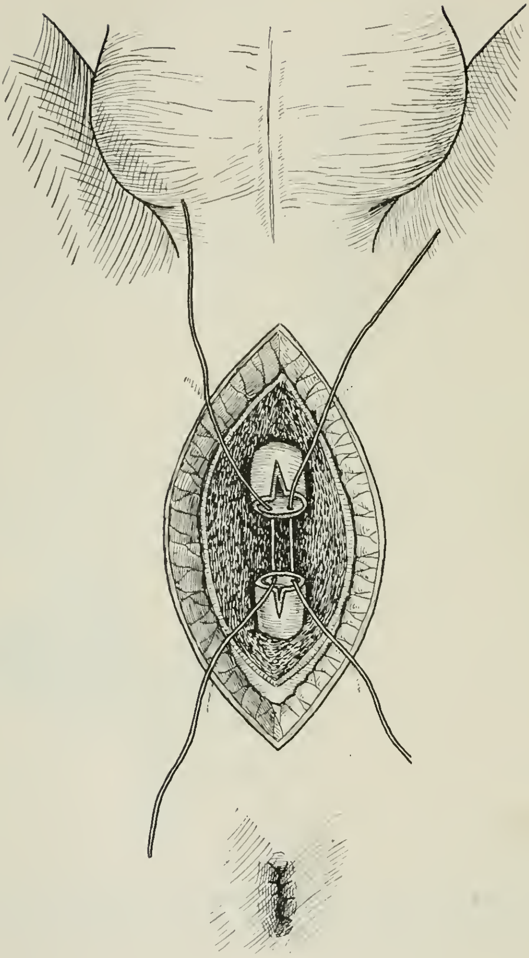

Fig. 2. Reproduced from Green and Brooks. Resection of the Urethra. Albaran Method

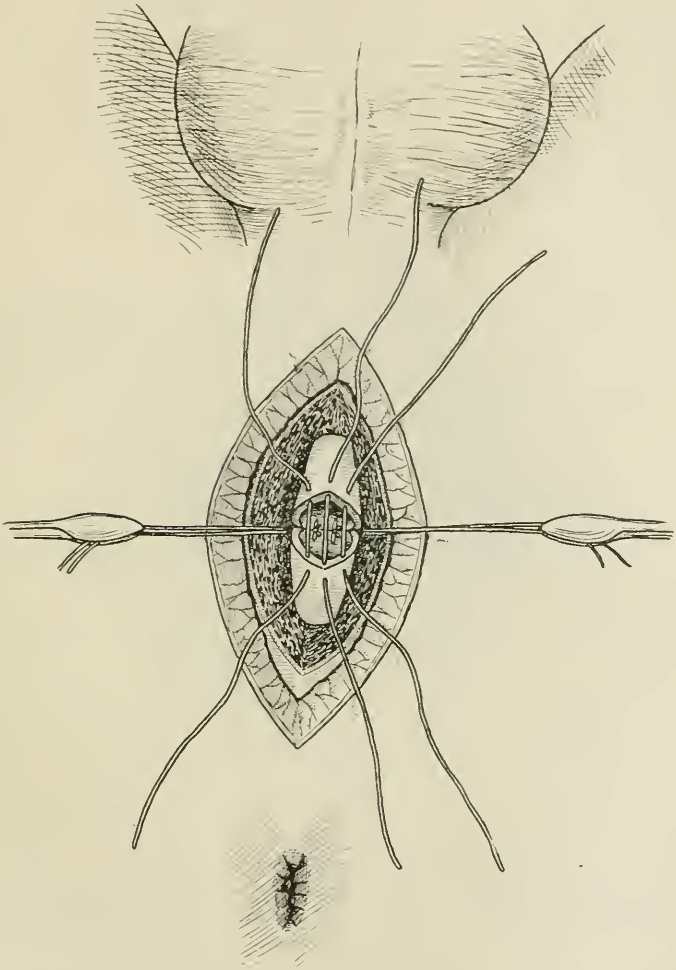

Fig. 3. Reproduced from Green and Brooks. Illustrating the Placing of the Stitches after Uniting the Resected Ends of the Urethra. Albarran Method

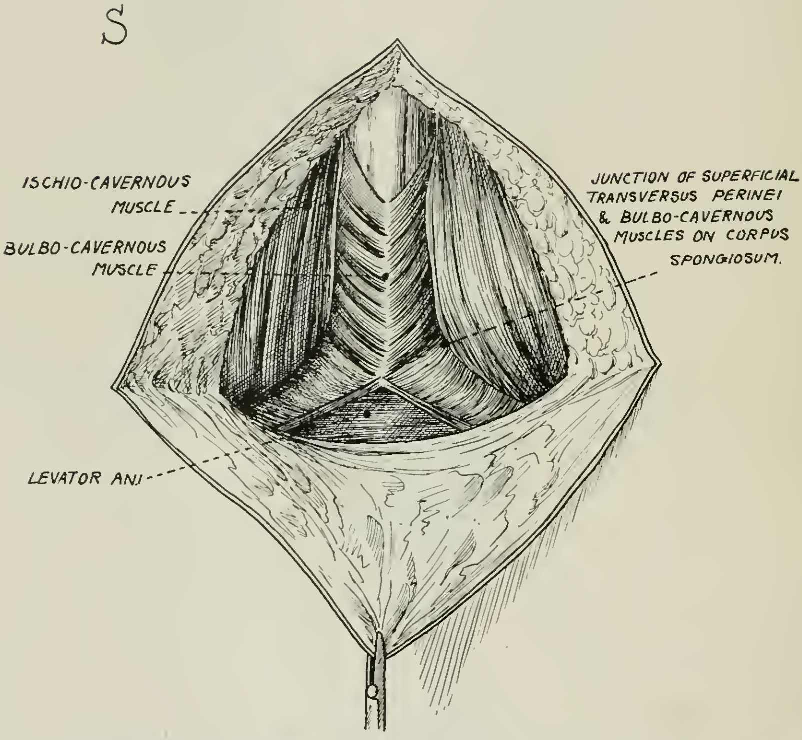
S
ISCHIO-CAVERNOUS MUSCLE
BULBO-CAVERNOUS MUSCLE
LEVATOR ANI
JUNCTION OF SUPERFICIAL TRANSVERSUS PERINEI & BULBO-CAVERNOUS MUSCLES ON CORPUS SPONGIOSUM.

Fig. 4. Reproduced from Maxmillian Stern. Showing the Arrangement of Muscle Tissues over the Urethra before Exposure of the Stricture

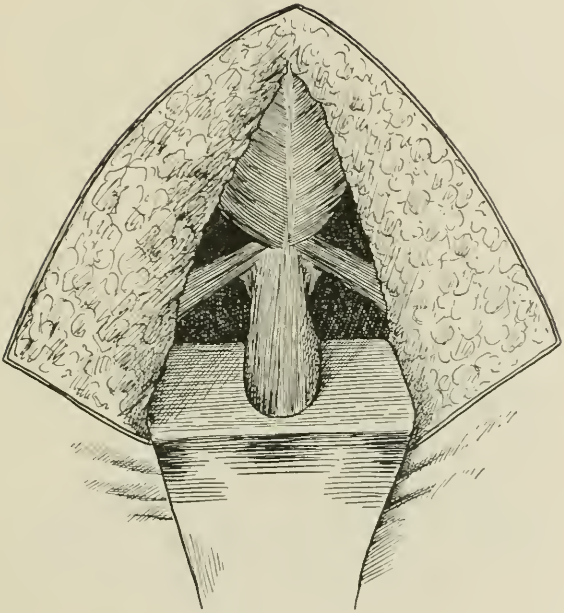

Fig. 5. Reproduced from Hamilton Russell. Illustrating Exposure of Central Tendon of the Perineum

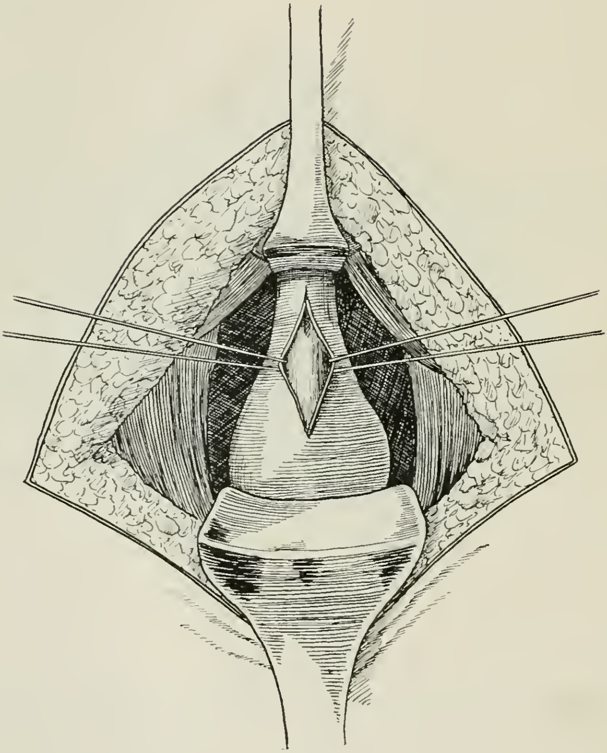

FIG. 6. REPRODUCED FROM HAMILTON RUSSELL. ILLUSTRATING THE OPENING OF THE URETHRA CLOSE TO THE STRICTURE

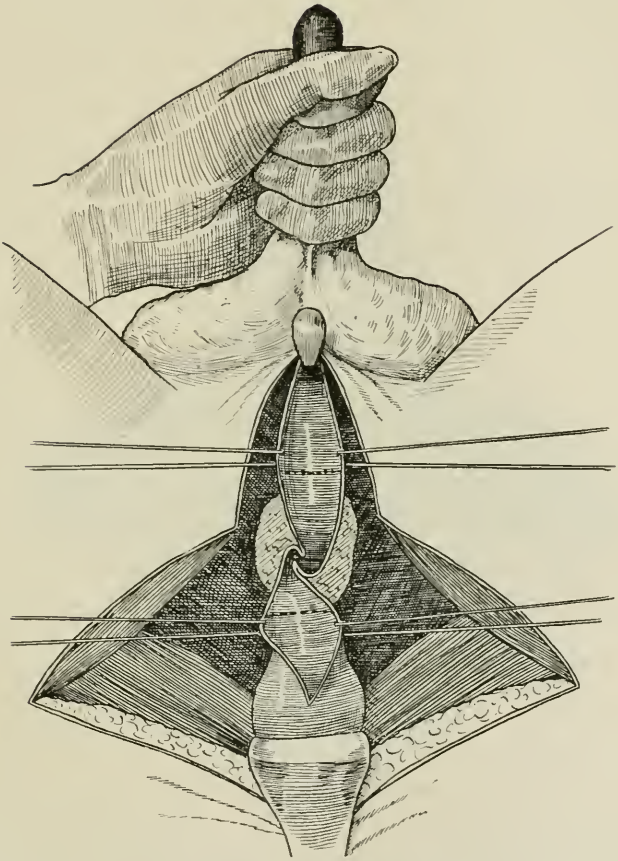

FIG. 7. REPRODUCED FROM HAMILTON RUSSELL. SHOWING THE URETHRAL TISSUES TO BE RESECTED

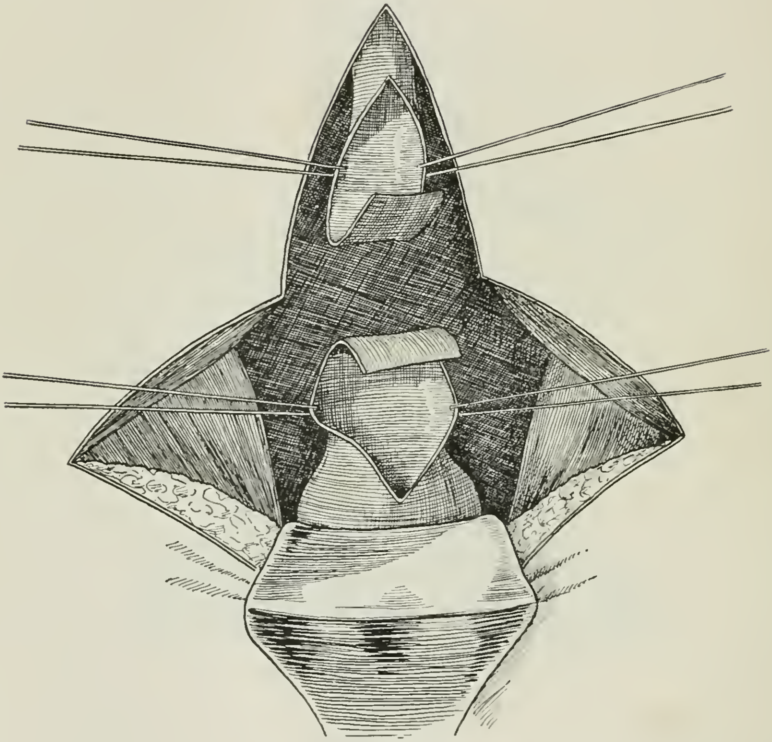

Fig. 8. Reproduced from Hamilton Russell. Illustrating Undercutting of Urethral Tissues after Resection

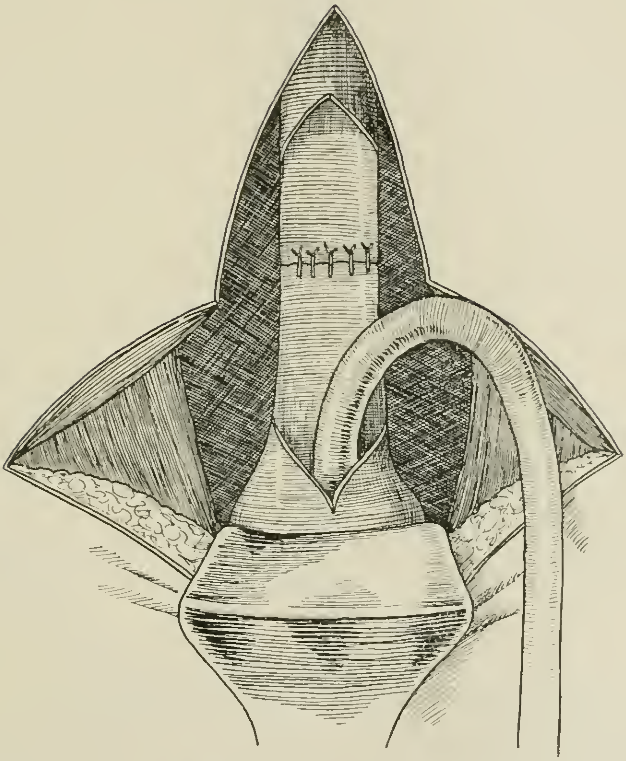

Fig. 9. Reproduced from Hamilton Russell. Illustrating the Uniting of the Undercut Urethral Tissues by Five Sutures, and the Placing of a Rubber Drain in the Proximal Portion of the Urethra

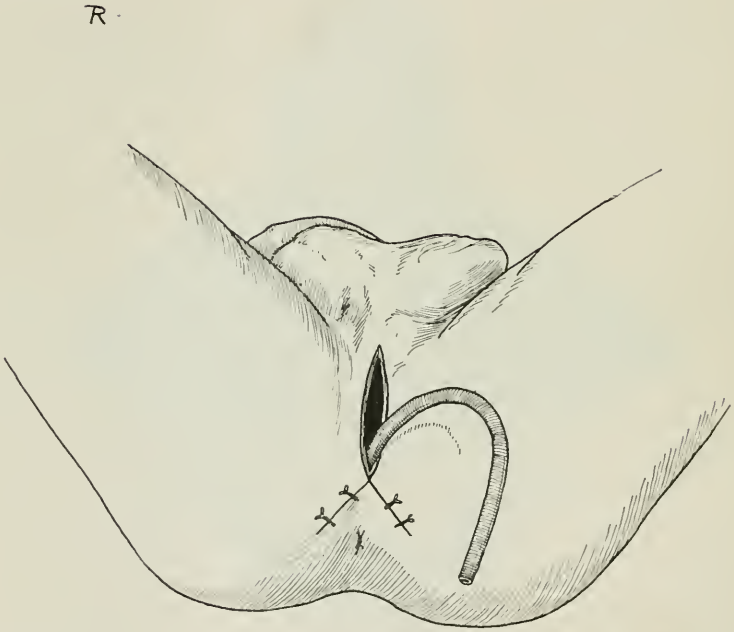

Fig. 10. Reproduced from Hamilton Russell. The Closing of the Skin

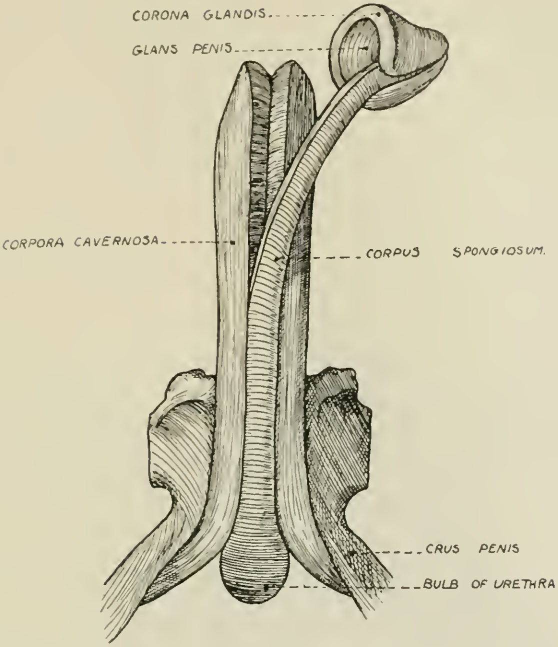

FIG. 11. REPRODUCED FROM GRAY'S ANATOMY. ILLUSTRATING THE EASE WITH WHICH THE CORPUS SPONGIOSUM SEPARATES FROM THE CORPORAE CAVERNOSA; ILLUSTRATING THE MOBILITY OF THE CORPUS SPONGIOSUM

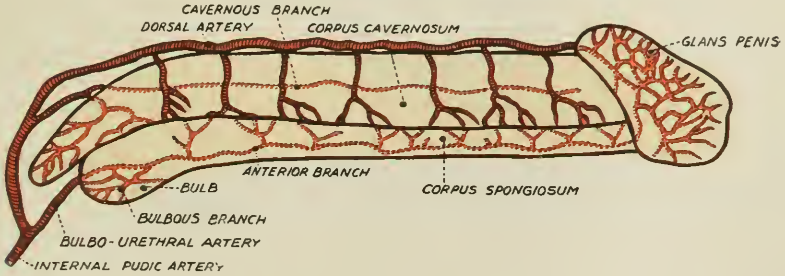

FIG. 12. REPRODUCED FROM TESTUT'S ANATOMY. ILLUSTRATING THE ABUNDANT ANASTOMOSING BLOOD SUPPLY OF THE CORPUS SPONGIOSUM

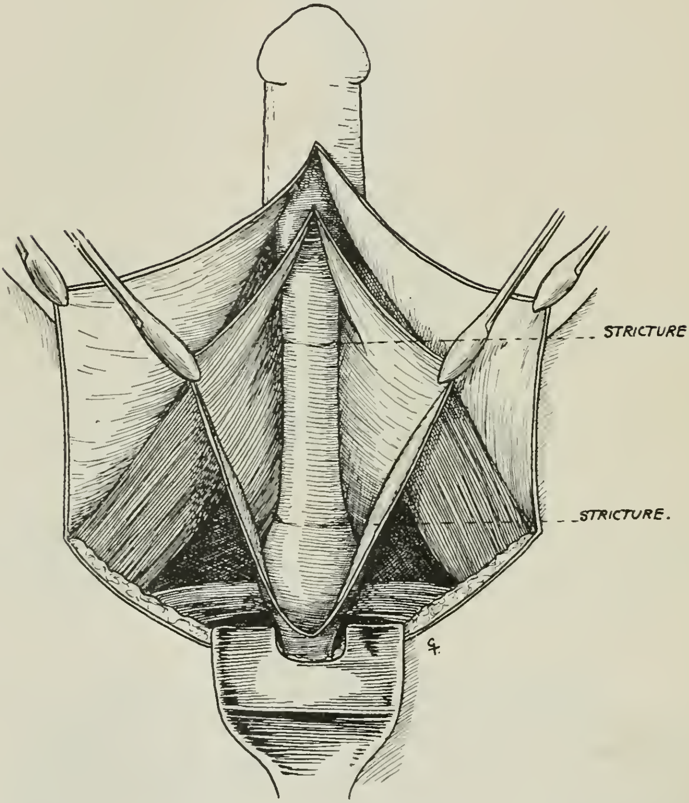

Fig. 13. MacGowan. Illustrating the Method of Exposing and Mobilizing the Stricture Tissues Before Resection

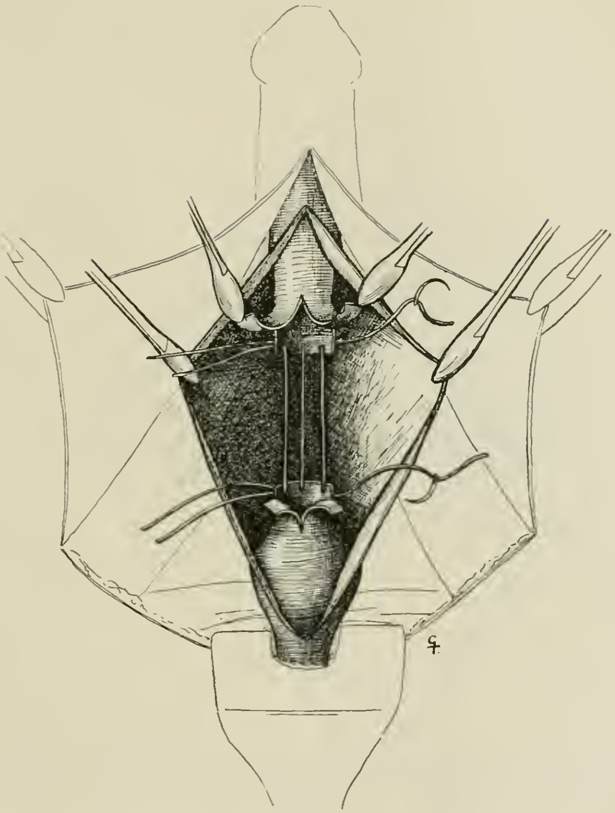

Fig. 14. MacGowan. Illustrating the Preparation of the Flaps of the Urethra and the Placing of the Stitches in the Flaps so as to Bring the Knots on the Outside of the New Urethra

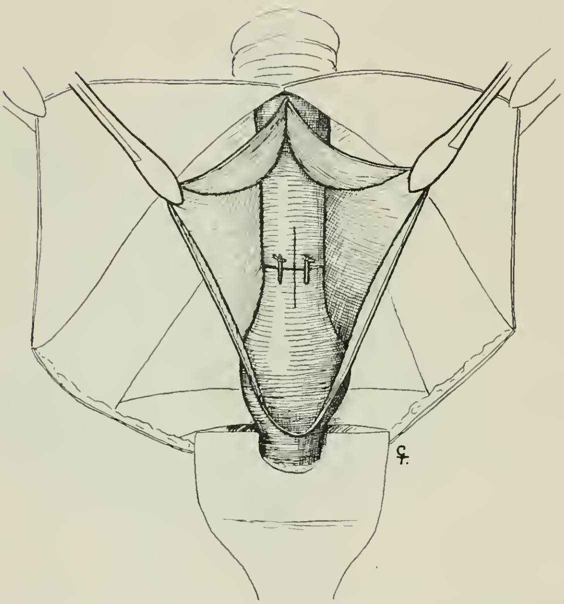

Fig. 15. MacGowan. Illustrating the Appearance of the Urethral Structures after the Resected Ends are Brought Together

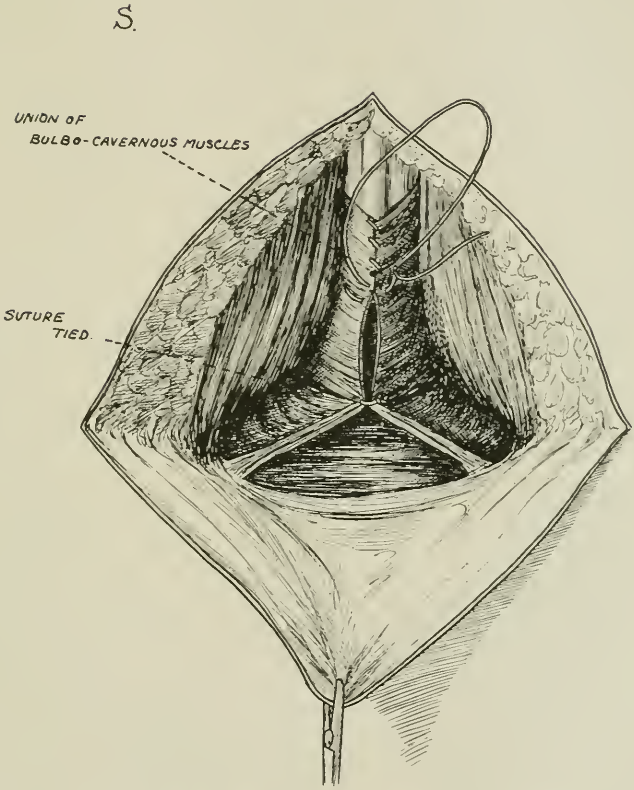

Fig. 16. Reproduced from Maxmillian Stern. Replacement of the Muscle Tissues in Their Proper Position Before the Closure of the Perineal Wound

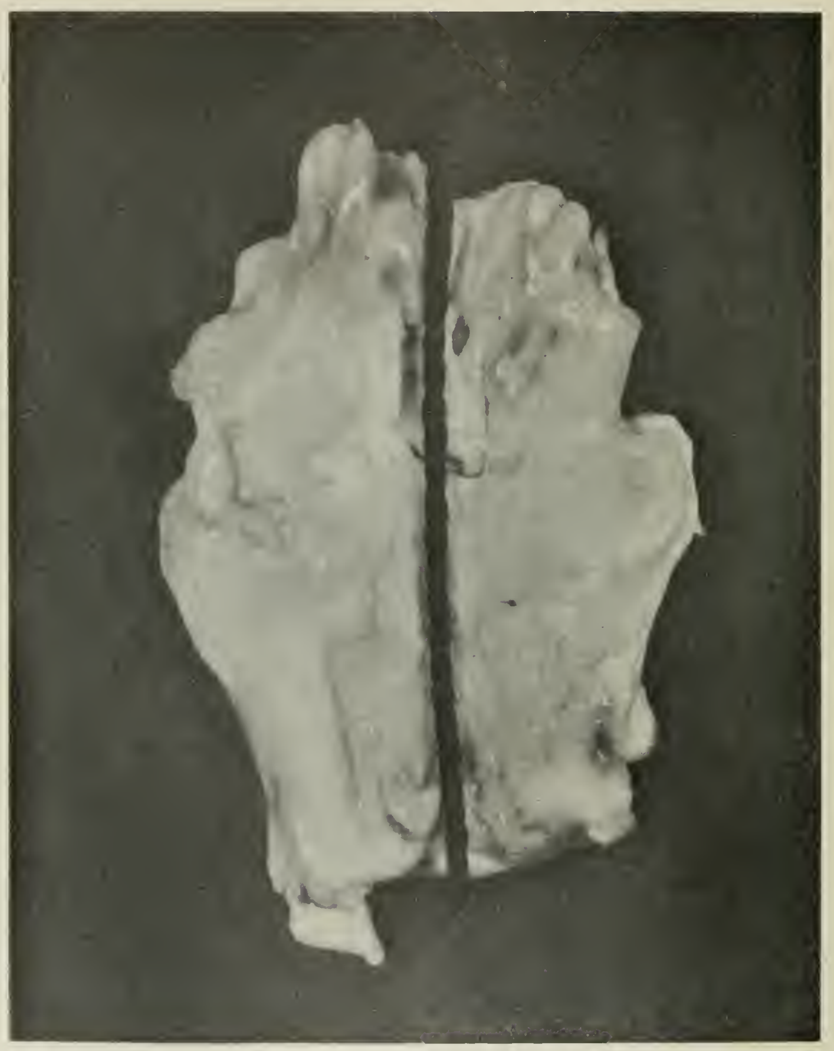

Fig. 17. Resected Portion of a Urethra, 8 Cm. in Length, in which a Satisfactory Union and a Patent Urethra were Obtained

The dark object in the center of the field is a piece of ordinary green wrapping twine, which quite fills the lumen of the sclerosed urethra.

DISCUSSION

Dr. H. L. Kretschmer (Chicago): I wish to discuss one or two points in Dr. Rathbun's paper. The complications which he listed under toxic psychoses, as he said, are rarely mentioned in the literature and less frequently in the text-books. I am sorry to say that I have had some of these cases of so-called toxic psychosis, which I have attempted to divide into three groups. In one group I believe the post-operative psychosis was due to senile changes in the brain; a second group I think are due to uremia; and then a third group I placed under the heading of toxic psychosis. This group of cases has given us a great deal of concern. They are hard to handle, and if the Doctor has any special way in which he handles these patients I wish he would tell us about it.

I thoroughly agree with him on the question of packing. I wish in closing the discussion he would say whether I understood him to say that in some cases where diverticula were found they did not have residual urine or obstruction.

Just a few words regarding the question of anesthesia. We have been recently using at the Presbyterian Hospital a new anesthetic, ethylene gas. It is administered the same as nitrous oxide—80 per cent of ethylene and 20 per cent of oxygen. So far it has worked well. We have used it as an induction to ether in kidney operations; we have used it in prostatectomies and in cystotomies, and for introducing radium needles through the perineum in cases of carcinoma of the prostate, all with very gratifying results. The patients who are anesthetized with this do not have the blue color, they do not become cyanotic. The color is fine and there does not seem to be much change in blood pressure; they wake up easily and with less nausea and vomiting. I think as soon as the experimental work is finished we will have an anesthetic which will work out very well in bad prostatectomy cases. We are inclined to think of sacral anesthesia as free of danger, and Dr. Lewis has told us of some interesting results, showing that sacral anesthesia is not free of all danger.

Dr. **Daniel Eisendrath** (Chicago): Dr. Rathbun stated that he only made 31 cystoscopies in 100 cases. I would like to ask him if he does not believe that cystoscopy should be done in a larger percentage of cases. The more I see of this work the more I am impressed with the necessity of cystoscopy, particularly that we may overlook some diverticula. I believe we have reduced the morbidity, as Dr. Rathbun has shown, but I do not believe we are perfectly satisfied with the end results. A great many of these patients do not clear up. They have purulent urine, and in a certain proportion of cases it is due to diverticula, and a cystoscopic examination will aid us in detecting these.

When you are making a cystoscopy, combine with it a cystogram. It can be done in a few minutes, and we make it a rule not only to take an anterior posterior view, but also a lateral view, placing the patient on his side and taking a view at right angles to the long axis of the pelvis. Not infrequently you will see the diverticula pointing toward the rectum, or behind the bladder that you would have overlooked in the anterior posterior view.

Dr. **George R. Livermore** (Memphis): The Doctor laid such great stress on the phthalein test, but I am inclined to rely upon the blood test. If both are satisfactory, well and good; but if the phthalein is low and the blood urea and creatinin are good, I am satisfied, because we know that phthalein sometimes in some cases has been known to act as a diuretic and give a large output of phthalein although the kidney is damaged to such an extent that operation would be inadvisable.

Another thing is the blood pressure. I like to have the blood pressure stationary, and it is our routine to have blood pressure examinations on successive days until it is stationary before we undertake operation.

In regard to the control of hemorrhage, it makes little difference how it is controlled, just so we do control it. I prefer the Pilcher bag because it is easily adjusted and controls hemorrhage perfectly, and the tube put in through the urethra acts as a splint for the denuded prostatic urethra. It also acts as a drain because it has an opening through which the urine and blood can drain. The Doctor cited 5 cases of severe hemorrhage, so that is in itself an indication of the responsibility that is upon us to see that hemorrhage is controlled. I am sure that all of you who have not packed or made some attempt to control hemorrhage have had bleeding in those cases in which you felt there was no danger of hemorrhage at the time of operation.

Dr. R. A. Hooe, Washington, D. C.: I wish to refer briefly to a case which appeared recently and which is of particular interest because of the extreme youthfulness of the patient. This was a young man aged twenty-six, who was treated by us five years ago for acute Neisserian infection, with recovery. He appeared in February stating that he had had quite a bit of difficult urination for the past six weeks or two months. He presented all of the signs of obstruction at the vesical neck. He was catheterized and there was 2 or 3 ounces of residual urine. The cystoscope revealed a left lateral adenomatous overgrowth at the vesical neck. This was dealt with by means of the high frequency current at two sittings. There was quite a little reaction following the first treatment, from which he rather promptly recovered. Two weeks later he was treated again by this method and then allowed to go. He came back after quite a bit of reaction and stated that the stream was better. He has now absolutely no residual urine and the bladder picture is that of a perfectly normal outlet.

We know that stricture of the neck does occur in the youthful, but I have never seen in the literature nor heard a case of this kind described in one so young.

If I did not misunderstand Dr. Rathbun, I would feel inclined to take issue with him on one point, and that is where he refers to masterly inactivity in the cases of prostatectomy with 6 or more ounces of residual urine. I think in many such cases a great deal can be done. I think many such cases, even with a greater quantity of residual, with the proper preliminary treatment such as Dr. Rathbun has instituted, can be saved from an early grave.

Dr. Gilbert J. Thomas (Minneapolis): I think we are very fortunate to have the opportunity of listening to a paper such as Dr. Rathbun has presented. He is desirous of bringing about some standardization of technique for suprapubic prostatectomy, which is commendable.

With this in mind, I wish to emphasize the necessity of obtaining the cause of death following prostatectomy. Comparatively few statistics are published concerning the pathological cause of death. If one searches the literature he will find very little information concerning this. I think we should have better and more statistics concerning the cause of death because this will assist us in changing or improving technique. I wish Dr. Rathbun would tell us the causes of death in the mortality he had.

Concerning caudal anesthesia, I think we are not using it enough. The technique is not hard; there is comparatively little danger. Dr. Lewis cited 2 or 3 deaths—I do not know what percentage, but it is not great. We had some difficulty when we used adrenalin, so that we do not use it now with caudal anesthesia. We have used large quantities and small quantities, 0.7 per cent up to 1 and 2 per cent, and the results seemed to be equal.

I think in prostatic surgery it is necessary to do a cystoscopy in practically all cases. There are certain individuals who have only 2 or 3 ounces of residual urine, and who may live out their usual life without operation. The only way we can know this is by cystoscopy. We must remember that cystoscopy can be made through the suprapubic wound, when one is present, as well as through the urethra.

Dr. H. McC. Young (St. Louis): The only point I wish to discuss is the subject of hemorrhage. Consider the condition immediately after the enucleation of the prostate. You have bruished the tissues which will swell, and if you pack the cavity and put in a Hagner bag and blow it up at once you exert pressure tissues before they have a chance to swell, very much as the surgeon would who splinted a fracture immediately after an accident with a tight bandage. You can expect necrosis. At the same time, something must be done to guard against hemorrhage. I believe the proper thing is to put in a Hagner bag, but not to blow it up. In two-thirds of the cases it does not have to be blown up. Where it does, the call generally comes in as late as three in the afternoon, four to eight hours after the operation. The interne is there and all he has to do is to blow up the bag. That seems to me to answer all requirements. You avoid the objection to the use of the Hagner bag, but it is there if necessary.

Dr. Robert H. Herbst (Chicago): I was particularly interested in the small percentage of diverticula found by Dr. Rathbun in his series of cases of hypertrophy of the prostate gland. I think this can be explained by the fact that he practised cystoscopy in only one-third of his cases. I believe it is important for us to have a pre-operative knowledge of the presence of these pockets and also to differentiate between the diverticulum which readily empties into the bladder cavity and the one which retains urine after the bladder has been emptied. The latter type have much to do with some of the cases of poor function seen following prostatectomy. We have been using the following method to differentiate the retention diverticulum from the one which readily empties into the bladder cavity. A contrast fluid such as sodium iodide is injected into the bladder and a cystogram is made. The fluid is then allowed to run out, air is injected, and another film taken. If the diverticulum is of the retention type it will show on the latter film still filled with the contrast fluid. A diverticulum of this kind is likely to prevent a good functional result unless it is removed at the time of the prostatectomy or shortly after.

Dr. Robert V. Day (Los Angeles): We have not had much success with the Hagner bag. Sometimes patients may continue to bleed until I take it out. I have had very little success with packing, because one over-dilates the cavity and is apt to have bleeding when the packing is taken out the next day. It seems to me in a two-stage operation that we should usually adopt the method of doing nothing at all until it is needful, having the patient watched all the time, and if there are any signs of bleeding, pack the bladder and not the cavity with three or more yards of gauze, after the method of Freyer. This requires a little ether or gas. It is rather cruel, but it will stop bleeding when other methods will not.

Regarding Dr. MacGowan's operation, I saw it three years ago and was astounded at the results in severe cases in which external urethrotomy had not been a success. I have followed it since then and the results have been extremely satisfactory.

Dr. H. H. Young (Baltimore): We are greatly to be congratulated on this interesting discussion on prostatectomy. Dr. Rathbun has certainly brought a very carefully studied series of cases which should be of great value, following the careful studies made by Hinman and Cecil a year ago. He has a splendid conception of the problem of carrying prostatectomies safely through operation, and a realization of the great danger of high residuals. In the non-infected bladder he has used vaccines, which I have not used but I am thoroughly convinced that the non-infected bladder is sometimes more dangerous than the infected bladder.

I also want to plead the use of the inlying catheter instead of merely suprapubic drainage. I think there is no doubt but that these very high residuals must be drained carefully, but not immediately, and if you do a suprapubic at once I believe they are more liable to have the kidney compressed and hemorrhage from the bladder and kidney pelvis from sudden relief from pressure. Personally, I have not found it necessary to do suprapubic drainage as a preliminary except in about 1 per cent of cases.

There is no question but the low phthalein shows a very serious condition in the kidney. If it remains low and stable even under the best form of drainage, these cases are often safely operable. The blood urea test is essential when the phthalein is low but the blood urea is not necessary or helpful unless the phthalein is low.

We have never had any case in which high phthalein was observed which show a badly impaired kidney. Phthalein gives a very accurate idea of what the kidneys can do. The blood urea is very important, and operation should usually not be undertaken when the blood urea is high, say over 0.60, because by drainage you can practically always get the blood urea down to normal.

Hemostasis is extremely important whatever operation you do. It is possible by the insertion of oil into bladder wounds to remove gauze with greater ease. I think it is well to avoid too great packing, but I think we must be careful not to let the patient go back in a condition where he may bleed because we did not use enough packing.

I want to congratulate the Doctor on his low mortality. It should be contrasted with those cases we have had in recent years which have shown a general mortality of 25 per cent by prostatectomy and one report made recently by a well known urologist who admitted 12 per cent mortality, in private practice and a 40 per cent ward mortality. Certainly cases of that kind cannot be properly taken care of before and after operation, and that is the thing that discredits the urologist.

As to the cause of death, I agree that it is important to have the details. If Dr. Rathbun is interested in our cases he will find we have given in detail in a recent article in Surgery, Gynecology and Obstetrics (May 1923, p. 589) the cause of death in 36 cases.

I agree with Dr. MacGowan that there has been too much ignorance and unnecessary fear of the perineum. I believe that is the reason why urologists have not used the perineal route more often. I do not say a perineal prostatectomy is the best thing, although I greatly prefer it myself; but there are so many other conditions that can only be attacked through the perineum, that I beseech you to master the anatomy and physiology of the perineum. If you want to treat cancer radically, or tuberculosis of the seminal tract, or infected seminal vesicles or incontinance, you must master the perineum, and as soon as you do and learn to recognize the tissues and muscles, it is an extremely simple problem.

Dr. Lewis is to be congratulated on bringing out a method of using caudal anesthesia instead of spinal. We use spinal anesthesia in cases of tuberculosis and other serious conditions contraindicating general anesthesia, but I believe in nitrous oxide anesthesia under which most cases can be done satisfactorily and with which I have recently had 198 cases of prostatectomy without a death.

Dr. Bransford Lewis (St. Louis): I wish to speak of two points in connection with Dr. Rathbun's paper, illustrating to my mind the necessity of doing a cystoscopy in all those cases in which prostatectomy is done. Two years ago I was consulted by a patient on whom a suprapubic prostatectomy had been well done the previous August by a good surgeon. There was nothing whatever in the prostatectomy wound, and drainage from the bladder was good; but the urine he passed was rotten—it was as rank as anything I ever came across. This had been going on from August to January, notwithstanding various washings internally and antiseptics that had been used. The cause was a very large diverticulum which branched from the bladder high up on the right, that had a cavity as large as the bladder itself. I inquired whether a cystoscopy had been done, and he said, "No." A good prostatectomy had been done with bad results because the diverticulum had not been discovered, which could have been easily done by cystoscopy.

One point in the preliminary drainage that I think is worthy of mentioning, and that is in cases of chronic retention—instead of 30 ounces I have seen 1 case in which there was 60 ounces of residual urine, and another in which there was 160 ounces. The crucial requirement in reducing this retention is to make the decompression gradually. There is one way to do that, and that is by a retained urethral catheter in which you put a plug, and make intermittent reduction of the contents of the bladder. If there is 40 ounces of residual, take out 40 ounces and put back 20 ounces of boric solution. Repeat this every three hours until within two or three days (or more, in some cases) you arrive at an empty bladder and continuous drainage. Since I have adopted that plan I have never seen any disturbance arising from the gradual, interrupted reduction of residual urine.

Dr. A. J. Crowell (Charlotte): Drs. Lewis, Young and others laid emphasis on the importance of not only drawing the residual urine, but advocated the use of the catheter. The point is why is it necessary? After you have emptied the bladder and have continuous drainage through the catheter, what advantage is there in doing a two-step operation? Why not finish the job all at one time?

I also wish to report two cases showing toxicity following the use of novocaine, very similar to that reported by Dr. Lewis, but not so much. We have had two cases in which there was considerable toxicity following the use of novocaine in sacral anesthesia for prostatectomy.

Dr. A. L. Chute (Boston): Spinal anesthesia seems to have encountered a good deal of criticism, but I would like to mention one great advantage of this type of anesthesia in controlling hemorrhage following prostatectomy. Since there is not the haste that one sees in inhalation anesthesia "to take off the ether" it allows one to pack the bladder temporarily over and over again, if this is necessary. In most instances this stops the bleeding. It is a great advantage I believe to send a patient back to bed with a suprapubic tube in his bladder rather than a gauze pack or a Hagner bag. This is to me another advantage that comes from the use of spinal anesthesia in prostatectomies rather than from any of the forms of inhalation anesthesia.

Dr. M. Lauterman (Montreal): We should give Dr. Rathbun a vote of thanks for having brought this subject before the Association, and for the very thorough manner in which he has gone into details. I also want to thank him for having emphasized what I have been doing for nearly thirty years—a three-stage prostatectomy: viz., catheter drainage, suprapubic cystotomy, and enucleation. I use bladder drainage by the indwelling catheter with a plug. I was taught as a student that it was rank heresy to empty an overdistended bladder completely.

The control of hemorrhage by packing is frequently used. I employ it myself as a routine method, but I always use a large drainage tube and pack through the tube. In that connection I want to refer to one case of toxic psychosis. The patient, himself a medical man, called my attention to the cause afterwards. It was iodoform poisoning. I did not know he had an idiosyncrasy to this, but when he recovered he told me so. I now employ bismuth gauze for packing and have had no trouble.

Dr. Nathan P. Rathbun (closing): I feel that my paper has been an entire success in accomplishing the purpose for which it was written. That purpose was to promote discussion. There is a very obvious difference of opinion as to the various points in the operation of prostatectomy, and I feel this is the place to thrash it out, and by finding out the difference of opinion that exists at the present time there will come from it a more nearly unanimous opinion some time in the future, and the operation will be made safer for the average operator.

Dr. Kretschmer spoke of toxic psychosis. I do not think uremia is a prominent factor. One cannot do a phthalein on these patients, and the blood chemistry does not amount to much in the presence of forced fluids. But one thing we do do, and that is when we feel it is safe we send the patients home to their home environment, and they promptly begin to get well. They would not get well if uremia was a prominent factor.

I believe diverticula in the walls of the bladder are congenital in origin. I have operated on 10 of these large diverticula, and in only 1 have I been able to demonstrate obstruction at the bladder neck.

The question of cystoscopy—50 per cent of these cases had acute retention of urine. These old men had large prostates and we put a catheter in and drained them, the diagnosis was obvious, and I do not see that there is much advantage in cystoscoping them.

Dr. Livermore says I emphasize phthalein. I do feel it is a most important test, and if I only had one test I should select that one.

This question of leaving some of these men and not operating upon them when they have only 2 or 3 ounces of residual urine—in a man of seventy-five who is able to get around and attend to business, who gets up once or twice at night and is fairly comfortable, I do not believe we should urge operation, even though it could be done safely.

The question of cause of death. Unfortunately I only had one autopsy in my 5 deaths. That was a case of pulmonary embolism. I have no time to go into the details of that.

As to hemorrhage, we all have our own methods of controlling it, and maybe some day we will agree on what seems best. The same is true of anesthesia. Each man has his own method, and perhaps some time we will arrive at a conclusion as to the best method.

RETENTION OF URINE DUE TO CONGENITAL HYPERTROPHY OF THE VERUMONTANUM[1]

HENRY G. BUGBEE AND MARTHA WOLLSTEIN

New York

On December 15, 1922, the following case was seen in consultation at the Babies Hospital. The child, G. S., was a male three and one-half years old. He had been sent into the hospital for polyuria and a urethral discharge which had been present since contracting a cold in December, 1921. He was a well-developed, well-nourished child. On admission the abdomen was distended. Palpation showed the bladder reaching to the embilicus, no tenderness or rigidity; kidneys, liver, spleen not felt. Other physical findings were negative. The urine was cloudy, 1007, alkaline, showed a trace of albumin, acetone and sediment of triple phosphates; blood urea 37.5; uric acid 4.61; X-rays were negative. The diagnosis on admission was urethral obstruction and secondary hydronephrosis. Cystoscopic examination December 15, 1922, the bladder was palpated at the level of the umbilicus. Under general anesthesia a small cysto-ureteroscope was passed which encountered a slight obstruction at the vesical neck. The bladder was atonic, showed slight trabeculation, no diverticula, no congestion. Each ureteral orifice was dilated to 1.5 cm. in diameter and clear urine containing flakes was discharged from each side.

The vesical orifice was dilated and the posterior urethra which was also of large caliber was easily examined as far as the verumontanum. The verumontanum was enormously enlarged, forming a ball valve obstruction of the prostatic urethra. There were no folds of mucous membrane above or below the verumontanum giving valve-like obstruction, but a definite blocking from the verumontanum itself. There were no folds or valves distal to the verumontanum. This patient left the hospital at Christmas time and has not as yet returned.

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[1] Read May 18, 1923, at Cleveland, Ohio, before the American Association of Genito-Urinary Surgeons at the Thirty-fifth Annual Meeting.

While the urological picture was clear cut I was doubtful of the correctness of my interpretation until talking the case over with Dr. Martha Wollstein, pathologist to the Babies Hospital, who assured me that a definite, rounded hypertrophy of the verumontanum itself entirely free from folds or valve formations of the mucous membrane could cause such an obstruction and that at the Babies Hospital were postmortem specimens to corroborate the correctness of such a lesion.

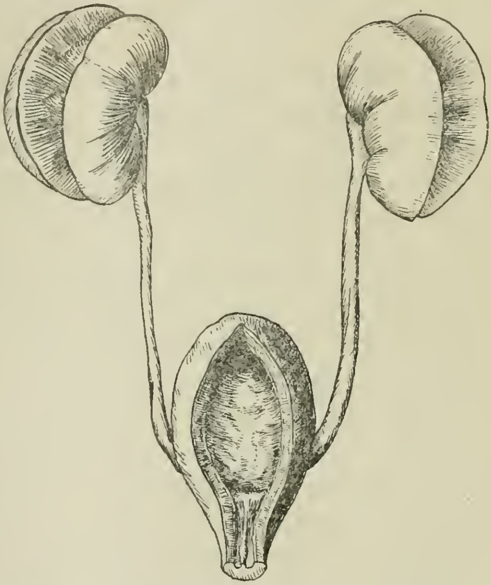

FIG. 1. NORMAL VERUMONTANUM, BLADDER, URETERS AND KIDNEYS

Microscopic examination of the normal verumontanum showed that it was made of the urethral mucosa composed of connective tissue with few elastic fibres. The arrangement was not a dense one. Glands and a few small vessels were present. The covering epithelium, consisting of several layers was intact. Behind the verumontanum was a cross section of the middle lobe of the prostate gland carrying the prostatic utricle and the ejaculatory ducts.

A review of the autopsy records of the Babies Hospital followed and revealed 6 cases of double pyonephrosis with dilatation of both ureters and 2 cases of double hydronephrosis with dilatation of both ureters. Seven of these 8 cases presented a definitely enlarged verumontanum which caused an obstruction in the prostatic urethra, the urethra being free from all valve formation or congenital malformation. The eighth case presented a valve-like fold of mucosa at the neck of the bladder to the vesical side of the verumontanum.

There were 5 cases of single hydronephrosis, 3 due to a valve-like fold of mucosa at the opening of one ureter, 1 due to atresia of one ureter and 1 due to double ureter with constriction near the kidney pelvis.

The ages of these children varied from three weeks to three and one-half years; all but 2 were under one year.

As complete autopsy specimens of 4 of the 7 cases presenting retention due to hypertrophy of the verumontanum were well preserved a drawing was made of them, also of a normal urinary tract for comparison. The case histories and autopsy findings of these 4 cases are as follows:

Case 1

W. N., history No. 6299, a boy thirteen months of age, admitted February 16, 1905. The chief complaint was colic and vomiting which had persisted for three days with a moderate fever, prostration, abdominal pain and constipation. The physical examination showed heart and lungs normal. The abdomen revealed tumors present in the left kidney region and right lower quadrant. The tumor in the left kidney region was tender and increased in size under observation. A catheter was passed easily, the bladder containing several ounces of residual urine which was cloudy, alkaline, contained a trace of albumin, few casts, many pus and epithelial cells and numerous micrococci; leucocytes 23,000.

The patient failed steadily and died on the tenth day after admission.

The autopsy record no. 508, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Double hydronephrosis and hydro-ureter. (2) Bladder hypertrophy. (3) Enlarged verumontanum. (4) Splenic hyperplasia. (5) Hyperplasia of lymph nodes.

Heart. Normal. Foramen oval closed.

Lungs. No pleurisy. No pneumonia. Both lungs were well aerated.

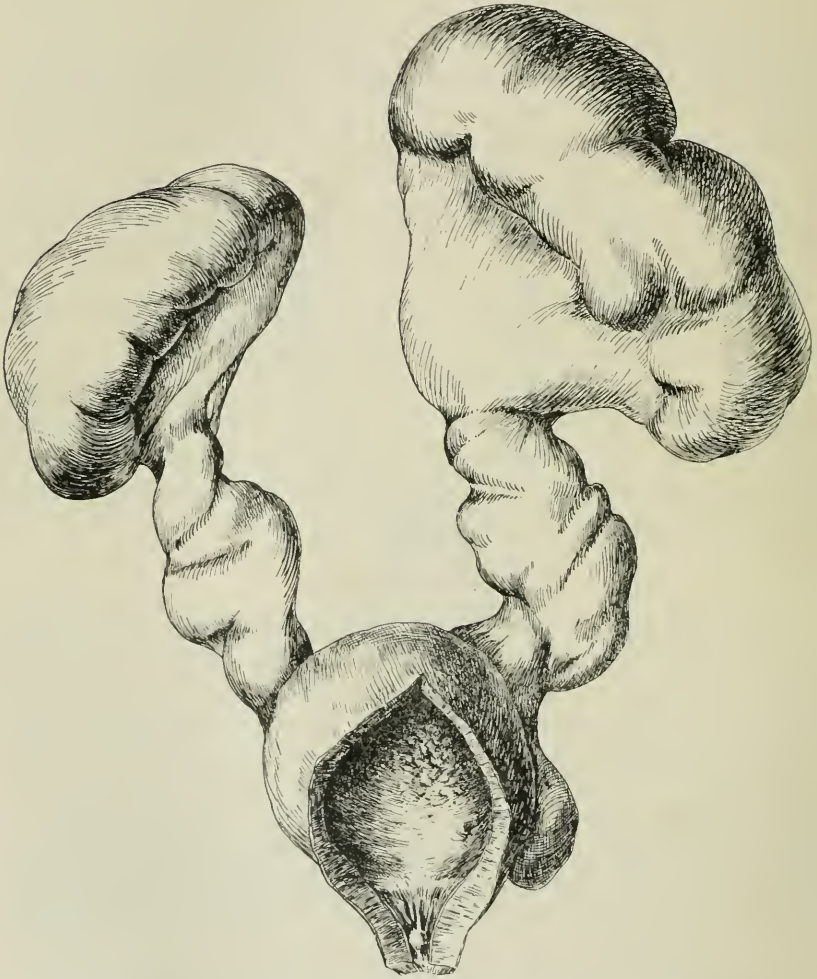

Fig. 2. Hypertrophy of Verumontanum. Hypertrophy of Bladder, Dilatation of Ureters, Kidney Pelves and Calyces. (Case 1.)

Bronchial lymph nodes. Normal.

Spleen. Ten centimeters long. Hard and firm.

Liver. Normal size. Congested. Not cirrhotic.

Stomach. Small. Mucosa normal. Empty.

Intestines. Normal throughout.

Mesentric and retroperitoneal lymph nodes. Slightly enlarged and red. None cheesy.

Kidneys. Left: 10 cm. long, lobulated, each lobule appearing like a cyst; the pelvis was funnel shaped 5 cm. high and 9 cm. at base, it being largest on the anterior surface of the kidney. *Its ureter was 7 cm. in circumference at the bladder.* The ureter had 4 curves in its course, and throughout was larger than the colon. *Right:* 12 cm. long, less cystic and more solid than the left. Pelvis more apparent on posterior surface and measured 6 cm. long and 3 cm. high. Its ureter had 5 curves and was slightly smaller than the left. On opening the kidneys, the left one was found to be converted into a bag of fluid, the walls of which were made by compressed kidney substance 2 to 4 cm. in thickness. All the calyces were markedly dilated and the pelvis was funnel-shaped, 9 cm. wide and tapered into the ureter. The right kidney showed less compression of the substance, which measured 6 to 10 cm. in thickness. The dilatation of the pelvis was less marked than on the right side.

Bladder. Measured 8 by 6 cm. and 14.5 cm. in circumference. The wall was 1 cm. thick. The mucosa was pale and there was no obstruction at the ureteral or urethral orifices. The neck of the bladder measured 2.5 cm. in diameter. The verunmontanum was enlarged to 0.5 cm. at its thickest point. No valve formation or folds of mucous membrane were found at vesical neck or in urethra.

Microscopic examination of verumontanum showed that it was composed of a fold of mucosa covered with stratified epithelium, the superficial layers of which were pealing. There were connective tissue and elastic fibers in the fold, more densely arranged than in the adjacent urethral mucosa. Glands were present. Behind the fold of the verumontanum was a cross section of the middle lobe of the prostate gland, with the prostatic utricle in its center and the ejaculatory ducts at either side. The lateral lobes of the prostrate were normal.

Case 2

L. B., history No. 22283, a male child five weeks old admitted February 15, 1923. The chief complaints were swelling the abdomen of two days duration and jaundice since birth. Examination showed a feeble month old baby, markedly jaundiced, blood count normal; heart and lungs were normal; abdomen showed liver and spleen enlarged, and a large, smooth, firm, round mass, somewhat movable in the right lower quadrant, a smaller, similar tumor occupying the left lower quadrant. A pyramidal mass occupied the suprapubic region ascending to the umbilicus which was markedly pouting and blue. This latter mass proved to be a distended bladder. The child died at the end of twenty-four hours.

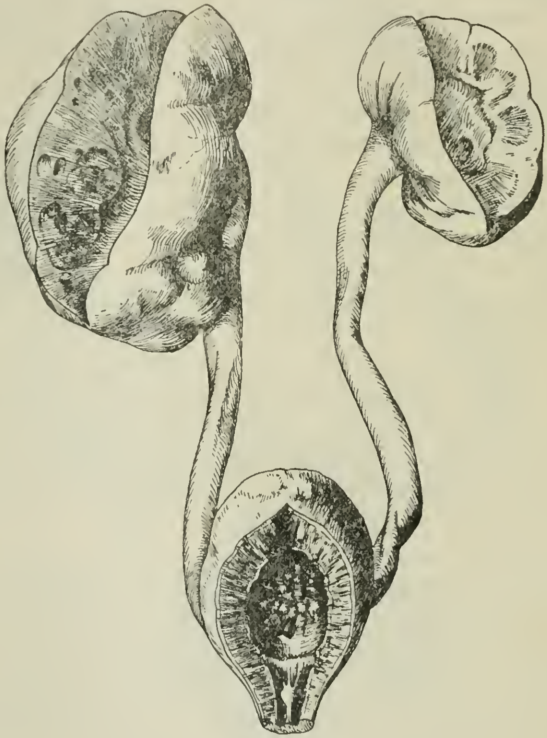

Fig. 3. Same as Fig. 2. (Case 2.)

The autopsy record No. 4678, by Dr. Wollstein is as follows:

Anatomical diagnosis. (1) General icterus. (2) Bronchopneumonia. (3) Purulent lepto-meningitis (streptococcus, non hemolyzing). (4) Double pyonephrosis: dilatation of ureters. (5) Cystitis and hypertrophy of bladder wall. (6) Enlarged verumontanum. (7) Otitis media purulenta. (8) Abscess of allantois.

The body was that of a well nourished, male, white infant, with marked icterus and distended abdomen. The umbilicus was dry and healed.

Brain. Dura mater normal. The sinuses contained fluid blood. The pia arachnoid was cloudy over the entire brain. At the base there was a purulent exudate, especially marked over the surface of the pons and medulla and under surface of the cerebellar veriform. The exudate extended up on to the outer surface of the cerebral hemispheres, but in small quantity only, along a few sulci. The ventricles were not dilated. The upper segment of the spinal cord did not show any exudate, but its pia was cloudy.

Middle ears. The right was normal; the left contained greenish pus in small amount.

Heart. Bile stained. The valves and the septa were normal. Muscle flabby. Ductus arteriosus and foramen ovale closed.

Lungs. No pleurisy. Anteriorly both were well aerated. Posteriorly there was a consolidated area in the apex of the right lower lobe, 2 by 3 cm. in diameter. This was acute bronchopneumonia, red and firm. In the left lower lobe a smaller and softer area marked an earlier stage of bronchopneumonia. The upper lobes were both free.

Larynx, trachea and bronchi. Moist, icteric.

Bronchial nodes. Not enlarged.

Spleen. Measured 8 by 4 cm. Soft, friable, red, capsule, wrinkled.

Liver. The liver extended 2 cm. below the ribs in the mamillary line. It was soft and showed parenchymatous degeneration.

Peritoneum. Normal.

Umbilicus. Healed externally. Its posterior surface was smooth. The vein (round ligament of liver) was not pervious. The arteries contained soft clots, but were not pervious. Between the umbilicus and the bladder, attached to the upper border of the bladder, was a swelling 2 by 2 cm. which was an abscess containing thin, yellow pus. It did not communicate with the bladder nor with the peritoneal cavity, nor with the umbilicus.

Stomach. The mucosa was normal. It contained blood stained mucus and blood.

Intestines. Many capillary hemorrhages into the mucosa throughout the small gut. There were no ulcers. The colon was slightly congested.

Mesenteric nodes. Not enlarged.

Pancreas. Normal.

Suprarenals. Normal.

Kidneys. The *right* measured 8 by 4 cm. and extended below the pelvic brim. Its surface was nodular. The *left* kidney was smaller and in its normal position, measuring 6 by 3.5 cm. in diameter. Both ureters were dilated and tortuous, 1 cm. wide. On section the right kidney showed a much dilated pelvic filled with yellow pus. The entire substance was riddled with abscesses, 2 mm. to 1 cm. in diameter. One calyx was much dilated. Several small hemorrhages were present where an abscess had eroded a vessel in the cortex. The left kidney showed a greatly dilated pelvis and calyces, with a much thickened lining. The kidney substance was compressed but showed no abscesses.

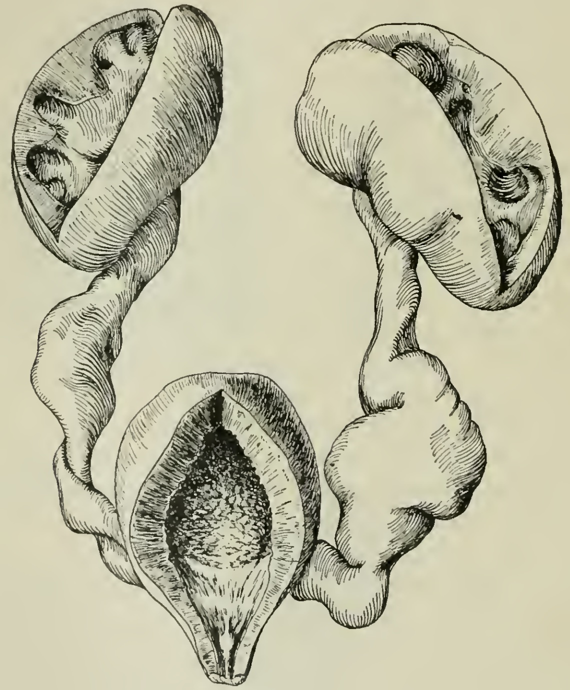

Fig. 4. Same as Fig. 2. (Case 3.)

Bladder. Measured 5 cm. long by 4 cm. wide. It contained 2 cm. of turbid urine. Its walls were greatly hypertrophied, measuring 0.5 to 1 cm. in thickness. The mucosa was congested, wrinkled and showed many submucous hemorrhages. There was a small fold of mucosa just above the trigone but apparently not interfering with the flow of urine.

The neck was dilated. The ureteral openings were large and readily admitted a probe. The urethra contained a very large verumontanum. No valve formation or folds of mucous membrane at vesical neck or in urethra were present.

Bacteriology. Heart's blood: streptococcus, non-hemolyzing. Right kidney: streptococcus, non-hemolyzing and B. coli communis. Meningeal pus: streptococcus, non-hemolyzing.

Case 3

A. H., history No. 4331, a male child thirteen days old, admitted October 25, 1910. The chief complaint was swelling of the abdomen and inability to urinate. The child had passed blood in the urine when three days old which had continued for three days. Urination was in drops. Appetite good, bowels regular, vomited the day of admission. As the child was moribund on admission a complete physical examination was not made. He was cyanosed, chest free, abdomen distended. There was a large, hard, smooth tumor in each iliac region and a third in the median line above the symphysis. Temperature 98, pulse 148, respiration 56. A catheter passed reducing the suprapubic mass. The urine was alkaline, heavy trace of albumin, many pus and epithelial cells, few casts and many colon bacilli. He died ten hours after admission.

The autopsy record No. 1199, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Double pyonephrosis and dilatation of ureters. (2) Hypertrophy of bladder. (3) Enlarged verumontanum. (4) Acute suppurative peritonitis. (5) Pulmonary congestion and edema. (6) Acute splenic tumor.

The body was well formed and well nourished. The abdomen was distended. The umbilicus was quite dry and healed. The umbilical vessels contained no pus.

Stomach. The stomach was distended with food and blood stained mucus. The mucosa showed large superficial erosions.

Peritoneum. The peritoneum contained about 30 cc. of turbid, yellow fluid. There was a recent exudate of fibrino-pus over the intestines, spleen and liver.

Spleen. The spleen was slightly enlarged, soft and covered with the exudate.

Liver. Congested and showed a few shreds of the exudate.

Intestines. No malformation.

Pancreas. Normal.

Suprarenals. Normal.

Mesenterics. Normal.

Heart. Normal. Foramen ovale open.

Lungs. No pleurisy and no pneumonia. There was very intense congestion and edema.

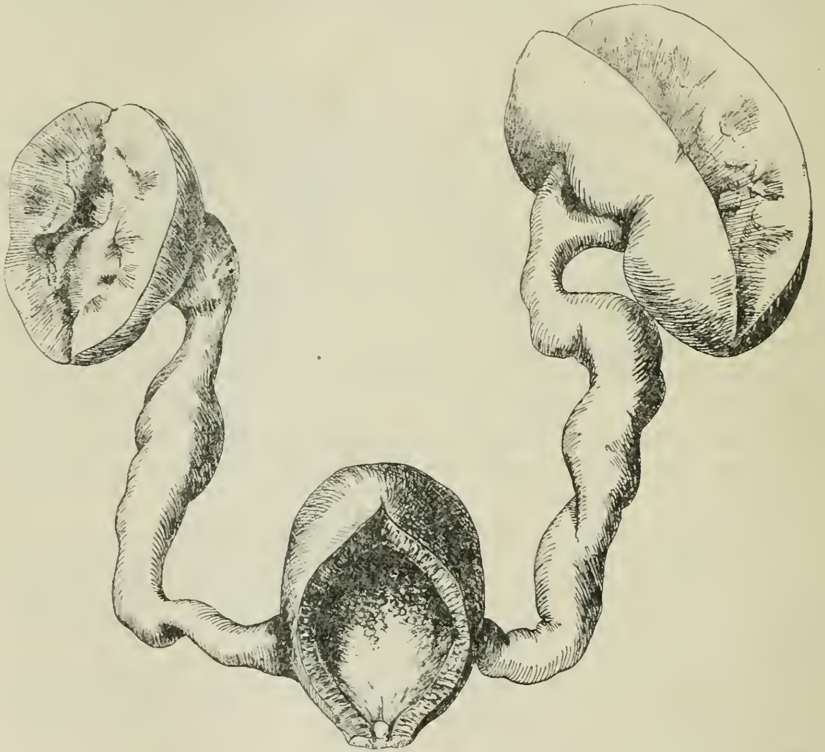

Fig. 5. Same as Fig. 2. (Case 4.)

Kidneys. The *left* measured 5 cm. long and 3 cm. wide. The pelvis and calyces were dilated, compressing the kidney substance to 0.30, while at the widest portion of a Malpighian pyramid it measured 1 cm. The opening into the ureter was 2 cm. and in its tortuous course the ureter measured from 0.5 to 2 cm. in calibre. There were small perirenal hemorrhages over the kidney, outside the capsules. The Malpighian pyramids contained small abscesses. The urine was cloudy.

The *right* was 6 cm. long and 3 cm. wide. The opening of the ureter was only 1 cm. in diameter. The calyces were dilated and the kidney substance compressed as in the left kidney, but there was less hemorrhage and more diffuse suppuration present in it. The ureter was more tortuous and wider than the left. Both ureters were wide at the bladder opening, and readily admitted a small probe.

Bladder. The walls were markedly hypertrophied, measuring 0.5 to 1 cm. in thickness. The mucosa was hemorrhagic in color and showed deep folds with many dilated blood vessels. The urethral opening seemed to be dilated and the fold of the verumontanum was greatly enlarged. There were no valve formations or folds of mucous membrane in the urethra.

Case 4

J. D., history No. 18845, a male child three and one-half years old. Admitted January 2 , 1921. The chief complaint was irritability and drowsiness of three days duration. He had convulsions when eight months old and one or two since then. For the past few days has been drowsy, irritable, feverish, constipated and refuses food. Until three days ago child was bright, took food well and appeared healthy. Urination painful and urine contains blood. Child fairly well developed, poorly nourished, lies on his back with head turned to left. Was very irritable and hyperesthetic. Left kidney palpated. Child died within twenty-four hours.

The autopsy record No. 4342, by Dr. Wollstein, is as follows:

Anatomical diagnosis. (1) Enlargement of verumontanum. (2) Dilatation of both ureters. (3) Double pyonephrosis. (4) Rachitis. (5) Bronchitis.

The body was that of a well nourished, poorly developed, white boy. No craniotabes. The legs were bowed, the ribs beaded. The skin was clear.

Lungs. The lungs showed no pleurisy and no pneumonia. Both were well aerated and showed no evidence of tuberculosis. There was a marked edema present on section of the lung, and a very marked general bronchitis.

Bronchial lymph nodes. Red and not large.

Heart. Normal.

Liver. The liver was large, congested and very slightly fatty.

Spleen. The spleen was large (10 by 5 cm.) a very markedly hyperplastic and the Malpighian bodies were prominent. There were areas of congestion.

Stomach. The stomach was empty and normal.

Duodenum. Normal.

Mesenteric lymph nodes. Not enlarged.

Kidneys. The *left,* 9 by 4 cm., was about twice as large as the right. It showed a markedly dilated pelvis with moderate compression of the kidney substance. Pus was present in one of the calyces. Suppuration was present in the pyramids and was extending into the cortex.

The *right* kidney was smaller than the left and contained no pus. The pelvis and calyces were markedly dilated. The substance was compressed and the markings blurred without the presence of purulent infiltration.

Ureters. Both were much dilated and tortuous. They measured 1 to 3 cm. in caliber.

Bladder. The bladder contained blood stained urine. The wall was slightly thickened and the mucosa deeply congested. There were many small submucous hemorrhages. The entrance to the urethra was blocked by the enlarged verumontanum, which made a papillary enlargement 1 to 2 cm. in height, blocking the egress of the urine. The openings of the ureters into the bladder were larger than normal. No valve formations or folds of mucous membrane in the urethra.

Bacteriology. Pus from left kidney, B. coli communis.

In a most comprehensive paper by Hugh H. Young, William A. Frontz and John C. Baldwin presented before this Association in 1919, the writers reported obstructions more or less complete, due to the presence of abnormal valves or folds in the posterior urethra, adding 12 cases to 10 reported in the literature previous to that time in which the diagnosis was confirmed by instrumental methods, operation or autopsy. The writers made a thorough review of the literature up to that time covering the embryological study of the deep urethra and verumontanum with reference to valve-like formations of mucous membrane, two types of which were more or less connected with the verumontanum and a third entirely separate from this structure but all quite distinct from the type of obstruction in the cases here reported. With the exception of this second case which was on autopsy record only and I believe was a case similar to the ones reported in this paper, the obstruction was due to folds and valve formations, not to hypertrophy of the verumontanum.

The literature since this excellent presentation contains no reference to the type of obstruction demonstrated by the cases we are reporting.

The pathology above the point of obstruction in our cases was identical with the descriptions of the cases given by Young, Frontz and Baldwin. The condition of the vesical neck and deep urethra was the same in each of our cases here reported, i.e., the vesical neck was dilated so that the urethra to the verumontanum formed part of the bladder. The verumontanum in each case formed an obstruction exactly like that caused by a more or less pedunculated median prostatic lobe. There were no folds or valve formations present, although most careful search was made at the time of the autopsy and in the specimens now available. A complete and accurate record was kept of 3 cases which were demonstrated at autopsy but are not included with this report of 4 cases, as the specimens have been lost. Sections of the verumontanum removed in one case of obstruction showed structure identical with the normal verumontanum, plus hypertrophy. The verumontanum presented the same gross appearance in each of the other specimens but was not removed that the specimens might be preserved.

The ages of the patients reported were thirty months in the living; the specimens thirteen months, five weeks, thirteen days, three and one-half years. Of 3 other cases of which we have autopsy record only, all were under one year of age.

A previous clinical history in such children, especially hospital cases, not under intelligent prehospital observation and brought to the hospital in a uremic condition or suffering from some complicating disease may throw little light on the condition and while the diagnosis in many cases will only be made at autopsy, any male child with a history of difficulty of urination or incontinence should be studied carefully with the possibility of a congenital obstruction of the deep urethra in mind.

Palpation and percussion of the suprapubic region, of either upper abdomen and flank, the passing of a catheter, a cystoscopic and urethroscopic examination and cysto-uretero pyelography should if possible be carried out.

The only hope of relief is in an accurate diagnosis of the lesion, if possible, before infection has supervened. The kidney function is always poor and with the advent of infection rapidly diminishes. The relief of back pressure should be gradual if possible, for suppression is to be expected with the establishment of drainage.

A cure can only be accomplished by removal of the obstructing verumontanum, best by fulguration or cautery either through a cysto-ureteroscope, suprapubically, or by open perineal operation as described by Young as one method of removing valve formations. The result will be determined largely by the amount of functioning kidney tissue remaining and the completeness of the removal of the obstruction. By impressing upon the pediatrist the frequency and importance of congenital anomalies of the urinary tract it may be possible to discover such obstruction lesions, more often in the living and to apply early treatment.

REFERENCE

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A STUDY OF ANESTHESIA IN PROSTATECTOMY[1]

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In the belief that an occasional check up of one's work is of definite value to those who have done the work and of possible interest to others, we have undertaken a study of 250 patients operated for different types of obstructing prostate in the Genito-urinary Service of the Massachusetts General Hospital.

There seems still to be a difference of opinion as to the choice of anesthesia in prostatectomy. Some persist in the use of ether, others prefer spinal anesthesia, while there are others, of which our clinic is an example, who use whatever anesthetic seems best suited to the individual case. The fact of the matter is, that none of the anesthetics now in use are ideal, although this goal may be reached some day, possibly in the form of sacral anesthesia.

This study has, therefore, been undertaken entirely from the viewpoint of anesthesia in relation to the group. At the outset certain difficulties and discrepancies must be acknowledged. The incompleteness of records has proved somewhat of a handicap, but, more important still, is the fact that it is impossible to express in any kind of record, no matter how complete, just what sort of a surgical risk each case appeared to be.

The fact that these cases were pretty generally divided between our staff of five or six surgeons gives a chance to view the combined results of all. It is also of value from the fact that during the past few years prostatectomy has undergone many changes in the matter of anesthesia, operative technic, and preoperative as well as postoperative care.

The analysis of these 250 patients taken as a whole offers some points of interest. The average age was between sixty-two and sixty-three years, the youngest being forty-one, the oldest eighty-three. The blood-pressure was found to be 150 plus systolic, 84 plus diastolic, each figure being an average for the group. There were 251 anesthesias, consisting of spinal in 101, nitrous oxid-oxygen in 78, ether (with or without preliminary nitrous oxid) in 68, and local anesthesia (infiltration of the gland and sacral) in 4. The mortality of the whole group was 18.8 per cent, consisting of 47 cases, comprising 28 spinal anesthesias, or 27.45 per cent, 11 ethers, or 16.1 per cent, and 8 nitrous oxid-oxygen anesthesias, or 10.2 per cent. An examination of the causes of death has been somewhat difficult for the reason that it was not definitely stated in some instances, while in others the patient had so many ailments, any one of which might be fatal, that it was sometimes impossible to decide which lesion closed the scene. Such as they are, however, the figures show sepsis was the predominating factor occurring in 20 cases (42.5 per cent); disease of the respiratory tract (pneumonia) was the chief factor in 7, hemorrhage in 6, renal insufficiency (uremia) and circulatory disturbances (embolus, apoplexy, myocarditis, etc.) in 5 cases each. In 4 instances it was impossible to determine the cause of death.

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[1] Published in the Surgical Clinics of North America, August, 1922.

Of the 251 operations, 48 were of the one-stage perineal type and 6 of the two-stage perineal type, giving a total of 54, or 21.1 per cent of the whole. Suprapubic operations were done 197 times (79.9 per cent), by the one-stage method in 117 cases, and by the two-stage method in 80. It may be said that although the one-stage suprapubic operation has been done more often, it includes mostly the early cases, whereas the two stage operation has been done almost exclusively in the later years.

Pathologic reports were recorded in 228 cases, showing adenoma in 193, carcinoma in 34 (14.9 per cent), and sarcoma in 1. In this connection it is extremely interesting to find that of the 34 carcinoma cases there were 10 deaths, giving a mortality of 30.3 per cent for this group, whereas of the 193 cases of adenoma, there was a mortality of 17.8 per cent, consisting of 34 cases. It would, therefore appear that the odds are against the patient with a cancerous prostate.

Hemorrhage was a definite factor in 27, or 10.7 per cent, of all cases. It was a postoperative event, requiring surgical intervention in some, 13 times. In the remaining 14 the description of the operation left no doubt that the hemorrhage was unusually severe and required definite measures for its control. It has already been stated that it was the cause of 6 deaths.

Pneumonia was noted in 32 cases (12.7 per cent), but the onset of this disease in relation to operation could not be determined in most. As already stated, it was fatal in 7 cases.

Our greatest difficulty was in determining what sort of a risk, from an operative standpoint, each case was. After various methods of estimating this point we finally hit upon a plan which was workable and the results of which seem to be reasonably accurate. Realizing that statements of opinion were too infrequent and too inadequate, we decided to rely only upon statements of fact, namely, blood-pressure, condition of urine, phenolsulphonephthalein excretion, and estimation of non-protein nitrogen. The general appearance of the patient as stated in the record was ignored except in those cases where it was said to be "bad." The factors enumerated were divided into three groups numbered 1, 2 and 3, the lower figure representing the most favorable condition. Blood-pressures between 130 and 160 systolic were put into the first column, those between 115 and 130 or between 160 and 180 systolic, into the second column, and those below 115 or over 180 systolic, into the third column. This division, while purely arbitrary, seems to us to be a fair method of estimation. In the case of the urine when it was "negative" or contained but a few blood- or pus-cells, it was put in column 1; when pus or blood or both were present in "moderate" quantities the second column was used; whereas when either or both elements were found in abundance, or when sugar was present, it was placed in column 3. If the phthalein output was 30 per cent or more, this was recorded in column 1; between 30 and 15 per cent was placed in column 2, and anything below 15 per cent in the third column. Non-protein nitrogen was placed in the first group when between 30 and 40 mgm. per 100 cc. of blood; in the second group when between

40 and 50 mgm., while any figure higher than this went into the last column. Where the general appearance of the patient was described as being unmistakably "bad," it was put in the third column. Each patient's risk was then worked out by this scheme, the figures added up, and recorded under "good," "fair," or "bad." In this way it was found that 78, or 34.9 per cent, were "good" risks (i.e., considering the fact that they were old men with damaged organs), 104, or 46.6 per cent, were "fair" risks, and 41, or 18.3 per cent, were "bad" risks. When it is considered that all these cases were of the usual hospital class this division would appear to represent the facts fairly accurately.

The relationship of "risk" and mortality was then investigated. Of the 47 deaths it was impossible to estimate the type of "risk" in 3. Among the remaining 44 about whom there is definite information, 13, or 29.5 per cent, were considered as "good," 18, or 40.9 per cent as "fair,' and 13, or 29.5 per cent, as "bad."

As our object in this paper is to determine so far as possible the relation of anesthesia to prostatectomy the patients have been divided into groups according to the type of anesthetic employed.

As already stated, 101 patients were given spinal anesthesia. Their average age was 64.5 years, their average blood-pressure 142 plus systolic, 82 plus diastolic. Twenty-eight died, 6 within forty-eight hours after operation (21.4 per cent), 22 at later intervals, giving a total mortality of 27.45 per cent. The causes of death, so far as could be determined, were as follows: sepsis, 12 (42.8 per cent); respiratory, 5; circulatory and hemorrhage, each 3; renal, 2.

Perineal operations were done in 30, with 9 deaths, 30 per cent; suprapubic operations in 71 (32 two stage), with 19 deaths, or 26.7 per cent.

The pathologic reports showed the percentage of cancer to be 11.2.

Severe hemorrhage at the time of operation was noted in 6, and occurred during convalescence in 7, a total of 13 cases, or 12.8 per cent. In 3 cases it was the cause of death.

Pneumonia occurred in 15 cases, or 14.8 per cent, and terminated fatally 5 times.

By our method of estimating this point, 35, or 38 per cent of this group were found to be "good" risks, 37, or 40.2 per cent, "fair," and 20, or 21.7 per cent, "bad" risks.

Of special interest and importance is the fact that 10 patients had what, for want of a better term, we have called "spinal reactions," and of this number 5 died, 2 the same day or the day after operation, 3 at later intervals.

In view of these unfortunate occurrences we feel that we must go into the details of the situation. Of the 101 cases, 29 were given tropococain, 26 novocain, 16 apothesine, 8 novol, 3 procain. The drug employed was not stated in 19, but as these were among the earlier cases, it is probable that tropococain was used. Of those having a reaction, tropococain was used in 4, novocain in 2, apothesine in 3, and procain in 1.

Where tropococain was used the dose varied from 1 to 2 cc.; in the case of novocain 2 (sometimes 3) "C" tablets were used. Novol and procain, being essentially novocain with a special trade name, were used in the same strength. Apothesine was given in 5 per cent solution, 2 cc. of this being used in most cases. In most the spinal needle was inserted in the space between the third and fourth lumbar vertebrae, and enough spinal fluid withdrawn into the syringe to make a total of 3 to 4 cc. (including the anesthetic) of fluid, which was reinjected into the spinal canal.

The reaction varied all the way from nausea and vomiting, sighing respiration, and a soft, slow pulse (these phenomena occurring within a few minutes after the administration of the anesthetic and lasting during the operation and for a few hours after) to a most alarming symptom-complex. When well marked this consisted of incontinence of feces, cyanosis, profuse sweating, thready, soft, slow pulse, sighing or gasping and shallow respiration, restlessness, and stupor. In a great many of the cases to whom spinal anesthesia is given a marked and sudden fall in the blood-pressure, both systolic and diastolic, takes place. In those having the reactions the blood-pressure a short time after the anesthetic was given was in several so low that it could not be recorded. We know of no more disconcerting event than the advent of the phenomena described, nor do we feel able to predict its onset in any given case. The 10 patients who exhibited the symptoms described were considered "good" in 2, "fair" in 5, "bad" in 3 (a proportion comparable with that of the whole group), and were in other respects not essentially different from the others who did not react unfavorably. Blood-pressure does not seem to be a factor, as in certain of the group not reacting unfavorably to spinal anesthesia it was only 100 mm. or thereabouts, and in the neighborhood of 200 mm. in others.

Turning now to the group which had ether or nitrous-oxid-ether anesthesia, there were 68 of these. Their average age was 60 plus years, and their average blood-pressure 155 systolic, 86 diastolic.

Eleven of these cases, or 16.1 per cent, died, 3 within forty-eight hours after operation, 8 at subsequent times. The lower mortality of this group as compared with the spinals is to be noted. Five of these men died of septicemia (45.4 per cent), 3 of hemorrhage, 2 of renal insufficiency, 1 of respiratory disease.

There were only 4 pneumonias, 5.8 per cent, as compared with 14.8 per cent for spinal, and only one of these died.

Cancer was found in 16.3 per cent.

Hemorrhage at the time of operation was noted in 2 cases, and as a postoperative event in 4, a total of 6, or 8.8 per cent. This figure is again lower than that for spinal anesthesia.

There were 17 perineal operations without a death; 51 were operated by the suprapubic route (20 two-stages), with 11 deaths, giving a death-rate of 21.5 per cent for this type of operation.

The man who was given ether appeared to be a somewhat better risk than his brother, who received spinal anesthesia, for it was found that he was considered to be a "good" risk in 34.4 per cent, a "fair" risk in 53.4 per cent, and a "bad" risk in 12 per cent.

Seventy-eight patients were given nitrous-oxid-oxygen anesthesia. The average age of these men was 64.2 years, and their average blood-pressure 148 systolic, 86 diastolic.

Of this group, only 8 died, giving a mortality figure of 10.2 per cent. There were no operative deaths, all occurring days or weeks after operation.

Among the causes of death sepsis again takes the lead, with 3 cases (37.5 per cent), circulatory disorders in 2, while renal insufficiency and respiratory lesions each furnished 1 death. It is notable that no death resulted from hemorrhage, early or late.

The pathologist reported cancer in 17.5 per cent of cases, and found 1 case of sarcoma.

Pneumonia intervened in 13, or 16.6 per cent, of this group, but resulted fatally only in 1 case.

The incidence of hemorrhage is interesting in that it was recorded as being of unusual severity at the time of operation in 6, and occurred during convalescence in 2, giving a total percentage of 10.2. The greater frequency of hemorrhage during operation may perhaps be accounted for by the increased venous congestion occasioned by the anesthetic.

The perineal operation was employed in this group but 7 times, with 1 death (14.2 per cent). Suprapubic operations were performed upon 71 of these patients (the two-stage type in 24), with a mortality of 9.85 per cent, consisting of 7 cases. According to our estimate of the risk 31.5 per cent were considered "good," 49.3 per cent "fair," and 19.1 per cent "bad."

Only a word can be said of the 4 cases having local anesthesia. In all a two-stage suprapubic operation was done. In 3 the prostate was removed after infiltrating the region of the gland with apothesine, using a spinal needle attached to a 10-cc. syringe. The anesthesia was not entirely satisfactory in 2, but in the third case is recorded as "good." In a fourth case sacral anesthesia (drug not stated) was employed, with "excellent" results. None of these cases died nor was their convalescence any different from that of many others. The anesthetic was employed solely for the purpose of trying it out.

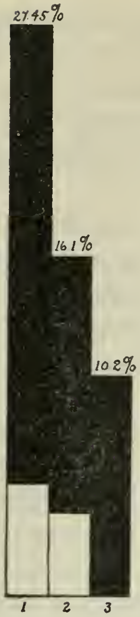

FIG. 1. GENERAL MORTALITY PERCENTAGES

1, Spinal anesthesia. *2*, Ether. *3*, Gas-oxygen. Unshaded portions indicate deaths within forty-eight hours.

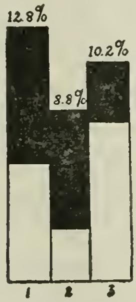

FIG. 3. HEMORRHAGE PERCENTAGES

1, Spinal anesthesia. *2*, Ether. *3*, Gas-oxygen. Unshaded portions indicate operative hemorrhage.

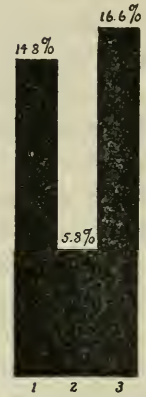

FIG. 2. PNEUMONIA PERCENTAGES

1, Spinal anesthesia. *2*, Ether. *3*, Gas-oxygen.

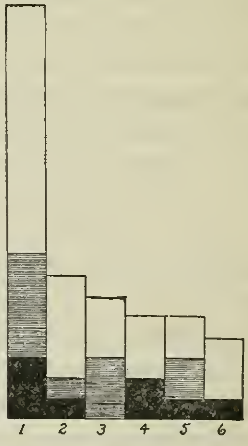

FIG. 4. CAUSES OF DEATH

Columns show percentage and actual numbers. *1*, Sepsis. *2*, Respiratory disease. *3*, Hemorrhage. *4*, Circulatory disease. *5*, Renal insufficiency. *6*, Cause undetermined. Heavy shading, gas-oxygen; light shading, ether; white, spinal.

A glance at the accompanying charts will show better than in any other way the essential differences not only in the type of men composing the three main groups of anesthesias, but also the incidence of other important items.

Figure 1 presents in a striking manner the great difference in the mortality of the three groups.

Figure 2 shows equally clearly the incidence of pneumonia, especially its surprisingly low percentage, in the ether group.

Figure 3 presents the story of hemorrhage in such a way as to emphasize its considerable frequency during operation with the use of spinal anesthesia and gas-oxygen, and comparative infrequency when ether is used. It is also to be noted that those having spinal anesthesia not only bled more frequently than the others, but did so about as much after as during operation.

Figure 4 shows beyond question that septicemia far outnumbered all other causes of death not only in the entire group of 250 patients, but in the spinal group as well. The small number of deaths from respiratory disease when ether was given is worthy of comment, and this anesthetic is completely guiltless of producing death by circulatory disturbances.

Figures 5 to 8 are an attempt to show not only the comparative numbers of "good," "fair," and "bad" risks but also the kind of anesthetic given to each. The latter point is a matter of fact, the former is admittedly a matter of more or less doubtful accuracy. We present our estimate for what it is worth, with full recognition of the fact that no accurate figures are possible. It must not be forgotten, however, that, right or wrong, the same method of estimation was applied to all cases, a point which makes us confident that the results shown in these four charts may have some element of truth.

While it may appear from this paper that spinal anesthesia is a most dangerous proposition, we do not believe this to be true. There is no doubt that if given improperly as regards either dosage or technic it is quite capable of resulting disastrously. The high mortality here recorded is, we believe, due not to the anesthetic or to the way in which it was given, but to the type of patient to whom it was given.

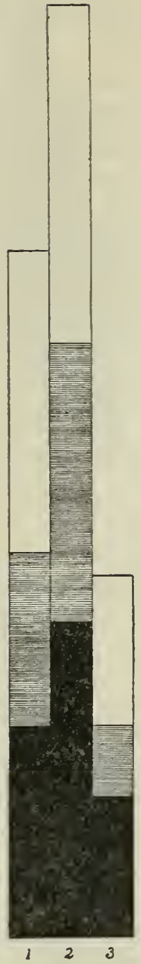

FIG. 5. TOTAL RISKS WITH ANESTHETIC GIVEN

Columns represent percentages. *1*, Good. *2*, Fair. *3*, Bad. Heavy shading, gas-oxygen; light shading, ether; white, spinal.

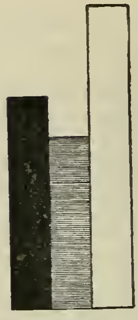

FIG. 6. GOOD RISKS AND ANESTHESIA

Columns represent percentages. Heavy shading, gas-oxygen; light shading, ether; white, spinal.

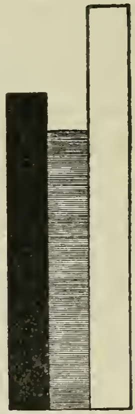

FIG. 7. FAIR RISKS AND ANESTHESIA

Columns represent percentages. Heavy shading, gas-oxygen; light shading, ether, white, spinal.

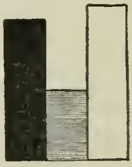

FIG. 8. BAD RISKS AND ANESTHESIA

Columns represent percentages. Heavy shading, gas-oxygen; light shading, ether; white, spinal.

We have shown that the age and blood-pressure was essentially the same in all groups; it was shown that cancer figured even less among the spinal group than among the others; it was also demonstrated in the best way we could devise that the man who was given spinal anesthesia was a "fair" or "bad" risk in about 61 per cent of cases, whereas in the ether group he was so recorded in 65 per cent and in the gas-oxygen group in 68 per cent. It is also true that the men who received spinal anesthesia outnumbered either of the other two groups in the matter of "good" risks.

On the other hand, when we consider what happened to the man who was given spinal anesthesia we are confronted with the fact that regardless of whether he was a "good," "fair," or "bad" risk by our method of estimation he certainly developed pneumonia with great ease, dying of it in more instances than those in the other groups; hemorrhage, both operative and postoperative, was a prominent feature, and finally he yielded to septicemia in more instances than did any of his mates, and died of it in nearly 50 per cent of cases. Finally, he died far more frequently than did the patient who was given ether or gas-oxygen. In other words, the trouble was with the patient and not with the anesthetic, and we feel justified in saying that had he been given ether or gas-oxygen instead of spinal anesthesia this particular type of patient would have died in even greater numbers. In other words, this particular type of patient was a bad risk from any standpoint, and would probably die after operation regardless of what anesthetic he received.

In closing we wish to state that we have purposely avoided drawing conclusions except in a few instances. The facts are presented solely on their merits, the reader being asked to make whatever deductions he can.

Our experience with prostatectomy among 250 cases of the hospital class shows that—

1. The gross mortality is 18.8 per cent, of which those dying after spinal anesthesia form the large majority for the reason that they are the poorest risks. But when it is recalled that about four-fifths of the deaths among the spinal group died several days or weeks after operation it is clear that one cannot

lay this mortality at the feet of the anesthetic. One must look for and actually find other causes which would indicate a very low resistance on the part of the patient to the various ills to which an old man is heir.

2. Cancer is found in about 15 per cent of cases.

Nearly one-third of these cases died, as compared with less than one-fifth of the adenomas.

3. Pneumonia occurs in about 13 per cent of cases.

4. Hemorrhage is to be expected in about 10 per cent, being an incidence of convalescence in about half this number.

5. Septicemia causes over 40 per cent of the deaths, with diseases of the respiratory tract, hemorrhage, and diseases of the circulatory and urinary organs next in order.

6. In any considerable group of spinal anesthesias an incidence of nearly 10 per cent of "spinal reactions" is to be expected, of which some are fatal.

7. In spite of its high mortality we believe that spinal anesthesia, given under proper conditions, is a safe and most satisfactory anesthetic.

THE USE AND ABUSE OF LOCAL URETHRAL ANESTHETICS[1]

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At the twenty-first session of the French Urologic Association held in Strassbourg in 1921, the subject of anesthesia in urologic procedures was made the order of the day at one of its meetings. It created a storm of personal opinions and no less than 21 men followed the essayists, Chevassu and Rathery, in the discussion of the subject. Again in 1922 at the meeting of the Societe Francaise d'Urologie, Marion again opened the subject, especially as regards the use of anesthetics in the urethra. Marion advocated the use of cocaine and gave his routine technique as follows: 3 to 4 cc. of a 4 per cent solution is injected into the anterior urethra, after a few minutes wait, the sphincter is forced with syringe pressure and 3 to 4 cc. more allowed to penetrate the posterior urethra and again after a short wait he injects by a similar method 10 to 15 cc. into the bladder. This sounds simple enough and safe, yet hardly a colleague of the many that took part in the discussion agreed with the author. Chevassu in his remarks quickly tabulated that with this technique 16 to 23 cc. of a 4 per cent solution is used containing 64 to 92 centigrams of cocaine and cites a death following a smaller dosage. Pasteau follows in the discussion with the remark that cocaine to him brings greater dangers and disadvantages than he is willing to concede to it aid in cystoscopy. Nogues states he "has a profound terror" for cocaine. Legueu says ''cocaine has been condemned for a long time for its dangers, incontestably admitted by all the world." Desnos speaking of this technique says "I dare not use it," and so on through the entire two sessions is sung the swan song of the urethral use of cocaine.

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[1] Read at the meeting of the American Urological Association, Rochester, Minnesota, May 21, 22 and 23, 1923.

Based on data received in reply to a circular letter sent out by the American Medical Association for its Committee for the Study of Toxic Effects of Local Anesthetics.

What is the attitude regarding this question of urethral anesthesia in our country? I wish to present it to you for discussion by drawing your attention to certain dangers that have been recently ascertained through a circular letter from the American Medical Association that many of you have been individually kind enough to answer.

AS REGARDS DRUGS USED

Cocaine, novocaine, procaine, apothesine and alypin represent practically the entire choice, some few preferring the addition of adrenalin to their solutions.

Interesting figures immediately appear. From 347 replies the following statements are drawn. Fifty-three men catagorically state they will not use cocaine; 18 others admit its use until recently, but have now completely discarded it, a total of 71 convinced of the dangers of cocaine, and pledged against its use. Contrasted to these are found 8 who state they use cocaine exclusively as a urethral anesthetic, to which may be added 27 others who ambiguously confess to using it or some of the newer synthetic drugs. In other words, 71 refuse to employ cocaine today and 37 admit its use, only 8 of whom use it exclusively.

Eighty-one urologists state their preference to be novocaine, though many take occasion to express their belief that cocaine is the anesthetic par excellence of mucous surfaces and cast doubt on the utility or efficacy of novocaine. Twelve prefer procaine, 7 use alypin and 4 apothesin.

STRENGTH OF DRUG USED

Again there appears a tremendous difference of opinion. The replies show that cocaine is used in from 0.25 per cent solution to a 20 per cent solution; from 0.25 grain tablets to pure crystals applied on a swab. Novocaine is advocated in strengths varying from a 0.25 to a 10 per cent solution. Procaine from 0.5 to 4 per cent strength, and alypin in 2 to 4 per cent strength, and apothesin in 1 per cent solution.

Tabulation

DRUG PREFERRED	NUMBER	STRENGTH
Use cocaine exclusively	8	0.25 to 4.5 grain tablet 1 to 20 per cent solution
Use cocaine occasionally	20	2 to 10 per cent solution
Use cocaine very seldom	6	
	34	
Refuse to use cocaine	53	
Have used cocaine and discarded it	18	
	71	
Use novocaine only	81	0.25 to 10 per cent solution
Use procaine only	12	0.5 to 4 per cent solution
Use alypin only	7	3 to 5 per cent solution
Use apothesene only	4	0.5 to 2 per cent solution

TECHNIQUE OF ADMINISTRATION

Meatal syringe injection, forcing the external sphincter by pressure or direct posterior instillation or tablet deposition are the methods in vogue. There does not seem to be any mention in any of the reports regarding a selection of cases. Though such might exist it seems more than likely that we are all subjects of that much to be dispised word routine and having once made a selection and trained our assistants the poor patient enters the groove and is treated in similar manner as his 99 predecessors were treated ahead of him.

DANGERS OF URETHRAL ANESTHETICS

Has this investigation demonstrated sufficient danger from the use of urethral anesthetics to materially alter our present conception and usage? It is immediately realized that fortunately none of us have had sufficient trouble to make a decided impress on our minds of the dangers in such usage of local anesthetics. Accumulated data alone speaks in loud enough tones to make itself heard and against this will be quoted immense statistics from very active clinics that lull to rest even these vivid figures.

Unfortunately these large clinic statistics bury their own dead rapidly and the poignant effect of a toxic case is soon forgotten in numerous non-lethal, non-toxic series. To me the oft repeated and positive statements in the letters that I have received as regards the positive refusal to use cocaine speak eloquently of moments of anxiety from experiences with the drug, and it of course is to be remembered that the replies that I have received but scratch the surface of the probably existant facts.

However, I believe them sufficiently striking to cause cocaine to be a forbidden drug in urethral work, and make us likewise hesitate to use any anesthetic in cases where abrasion of the mucous membrane may take place.

FATALITIES AND TOXICITIES

There were sent out 873 questionnaire letters; there have been received 347 replies, approximately 40 per cent. I have the records of 6 deaths from the urethral administration of a local anesthetic; 5 are due to cocaine! This is not a large number, but let me put the query—why these six?

Fatalities

NUMBER	DRUG	CAUSE FOR USE	OPERATION
1	Cocaine, 4 per cent	Cystoscopy	Immediate collapse
2	Cocaine, 2 per cent	Cystoscopy	Cystoscope
3	Cocaine, 2 per cent	Stricture	Sounds
4	Cocaine, (?)	Stricture	Sounds
5	Cocaine, 0.5 per cent		
6	Alypin, 4 per cent	Stricture	Soft catheter

I have recorded 38 cases of alarming intoxication from the urethral administration of a local anesthetic; 25 of these 38 are due to the use of cocaine! It is hardly necessary to add that in every case the drug was used to aid urethral instrumentation, but it is likewise worthy of note that three times immediate collapse precluded the instrumentation.

Novocaine is responsible for 5 cases of alarming toxicity. Procaine caused 4 cases of intoxication. Alypin caused 1 death and 3 intoxications and apothesin 1 severe toxic reaction.

Toxicities

NUMBER	DRUG	CAUSE FOR USE	OPERATION
1	Cocaine (crystals)	Stricture	Sounds
2	Cocaine (crystals)	Stricture	Sounds
3	Cocaine, 5 per cent	Stricture	Urethrotome
4	Cocaine, 5 per cent	Stricture	Urethrotome
5	Cocaine, 4 per cent	Stricture	Immediate collapse
6	Cocaine, 4 per cent	Stricture	Cystoscope
7	Cocaine, 2 per cent	Stricture	Sounds
8	Cocaine, 2 per cent	Stricture	Cystoscope
9	Cocaine, 2 per cent	Stricture	Cystoscope
10	Cocaine, 1 per cent	Stricture	Sounds
11	Cocaine, 1 per cent	Stricture*	Sounds
12	Cocaine, 0.5 per cent	Stricture	Sounds
13	Cocaine, 0.5 per cent	Stricture	Sounds
14	Cocaine (?)	Stricture*	Sounds
15	Cocaine, 0.25 grain tablet	Stricture	Sounds
16	Cocaine, 10 per cent	Cystoscopy	Cystoscope
17	Cocaine, 10 per cent	Cystoscopy	Cystoscope
18	Cocaine, 5 per cent	Cystoscopy	Cystoscope
19	Cocaine, 5 per cent	Cystoscopy	Cystoscope
20	Cocaine, 0.5 per cent	Cystoscopy	Cystoscope
21	Cocaine, 2.25 grain	Cystoscopy	Cystoscope
22	Cocaine, 0.25 grain tablet	Cystoscopy	Cystoscope
23	Cocaine, 2 per cent	Catheterization	Immediate collapse
24	Cocaine, 4 per cent	Acute urethritis	Instillator
25	Cocaine, 2 per cent	Ureteral calculus	Catheter
26	Novocaine, 4 per cent	Stricture	Sounds
27	Novocaine, (?)	Stricture	Sounds
28	Novocaine, 4 per cent	Cystoscopy	Cystoscope
29	Novocaine, 0.5 per cent	Cystoscopy	Cystoscope
30	Novocaine, 2 per cent	Ureteral calculus	Catheter
31	Procaine, 4 per cent	Stricture	Sounds
32	Procaine, 4 per cent	Stricture	Sounds
33	Procaine, 2 per cent	Stricture	Sounds
34	Procaine, 4 per cent	Cystoscopy	Cystoscope
35	Alypin, 4 per cent	Cystoscopy	Cystoscope
36	Alypin, 2 per cent	Cystoscopy	Cystoscope
37	Alypin, 2 per cent	Stricture	Sounds
38	Apothesene, 1 per cent	Stricture	Sounds

* Several cases.

In closing it is a pleasure to record the report of several specialists and teachers to the effect that they do not consider any anesthetic necessary in urethral instrumentation. That it is a marked disadvantage and danger in cases of strictured urethra hardly needs comment, where loss of sensation lures the operator on to misguided efforts and where unhealthy mucous membrane possesses rapid and dangerous powers of absorption. For cystoscopy, particularly selected cases need it, but in the vast majority I feel the words of Chevassu express a dictum that cannot be too often repeated: "Mais les meilleures anésthesies locales de l'urètre et de la vessie ne valent pas grand'chose si elles n'ont comme corollaire cette douceur extrême de mouvements, cette légèreté de main, cette délicatesse de doigté, sans lesquelles il n'y a pas de bon urologue."

DISCUSSION

Dr. James A. Gardner (Buffalo): I have used cocaine in my office for eighteen years, and for about 50,000 treatments. I have never seen the trouble that these other men seem to have had, and I think there is a good deal in the strength we use.

Originally, when our practice was smaller, we bought cocaine solution, 4 to 8 per cent, and often some of it would stand some time before it was used. As cocaine became more expensive, we tried a weaker solution, and also making it from tablets, and making it fresh, a hot solution. Later came the suggestion to use a alkali with cocaine, using 1 grain of sodium bicarbonate with 1.125 grain of cocaine, and we would make up a 2-dram solution, which is equal to 0.5 per cent cocaine. This solution will anesthetize the urethra as well as 4 per cent which has stood for two or three hours. We use this as a routine proposition. I think the use of this fresh, hot solution, not over 0.5 per cent and alkaline, is the reason we have no nausea.

It pleases me to hear Dr. Randall say that many people feel it is not necessary to use a local anesthetic. I have heard this statement many times. My friends say it does not hurt, so that a local anesthetic is not necessary; but I notice when you are taking care of a doctor he is always willing to have the pain eliminated. If you want to find out what a physician is doing, just refer a chronic patient and he will tell you whether there was any pain when he passed the instrument.

I hope there will be very frank discussion of this subject, because I feel that cocaine is in bad repute owing to the way it has been used.

Dr. George R. Livermore (Memphis): I do not like to take issue with our President, but I am one of the men who is very definitely afraid of cocaine. I have seen some very bad results from its use, but have never had a fatality.

In regard to the strength, Dr. Randall states that one man reports he uses 16 to 20 cc. of 4 per cent solution. That seems an outrageous amount of cocaine. Our old preceptor at college used to say that 0.5 to 0.75 grain of cocaine was safe, and if you did not give more than that, your patient might have fainting and weakness, but he would not die. So we have tried to stay within that limit, and yet I have had some very serious cases of shock and fainting. We use alypin entirely and have never seen any unfavorable results. I am very much surprised to hear of the death from alypin. I thought it was practically harmless.

I wish to report a death, one which Dr. Randall did not have in his cases, where one of our local men used a 5 per cent solution. He injected 5 cc. into the anterior and posterior urethra with urine in the bladder. He waited five minutes after doing this and then introduced the cystoscope. He sat down and began the examination, and the patient said "I am dying." The doctor immediately withdrew his cystoscope, but despite all efforts the patient died in a few minutes.

Dr. Randall did not tell us what he used. I would like him to speak of that. I am one of the doctors who have had ureteral calculus and have been cystoscoped. Alypin was used with me and it was very successful.

Dr. Victor D. Lespinasse (Chicago): I happen to be on the side of cocaine. For a long time I was one of the men who used the cystoscope without any anesthetic at all, but I found that it hurt my patients, so I decided to try to use an anesthetic, and finally selected cocaine. Three-quarters of a grain of cocaine is the smallest amount that has ever produced a fatality. I use 1 per cent solution 10 cc. This equals about 1.5 grains. Consequently if every bit of the cocaine I inject gets into the blood stream you are still on relatively safe ground. As it is extremely unlikely that even under the most favorable conditions for absorption, one-half would be absorbed, then you are absolutely safe. This is made up with cocaine crystals and distilled water. It lasts about two weeks. We never use a solution that is contaminated or that is not fresh. It is the French technique—5 cc. anteriorly, then ten minutes after 5 cc. more, forcing the first 5 cc. into the bladder. Then wait ten or fifteen minutes and proceed. We have used this method and have only had one case of anxiety, and that happened to be a man who after I had begun I found had an idiosyncrasy to cocaine. He fainted. That is the only bad effect we had.

In regard to apothesin, it was very unsatisfactory in my hands. I could not obtain anesthesia with it, and we obtained a peculiar reaction. It produced an irritation of the urethra and semi-erection, a very disagreeable and painful condition. We tried it in 6 or 7 cases and obtained this result every time, so we decided it was not satisfactory for surface anesthesia in the urethra.

Dr. Ernest G. Mark (Kansas City): It would seem to me in the selection of an anesthetic and in the review of these tables by Dr. Randall, that there is more to be considered than appears in the tables. I recall one of our excellent internists telling me that he had a man who was a perfectly good risk—he had a large prostate—and to go ahead and operate him. I saw the man and he seemed all right, but the next morning he was dead. He did not die from cocaine poisoning. He died from a mesenteric thrombosis. It is quite possible, and indeed quite probable, that some of these deaths do not occur from cocaine. These men would probably have died anyhow.

We use 2 per cent solution of cocaine right straight along for cystoscopy. I instil it into the posterior urethra, using anywhere from 1 to 2 drams of a 2 per cent solution. Following that I put a few drops into the anterior urethra, and in an experience of about twenty-three years I have never seen what I could call a dangerous symptom on the table or afterward. You find patients fainting, but they would faint anyhow.

I think the personal equation and selection of cases are two main factors we must consider. I would not put cocaine into a bleeding bladder, or where I knew I had a soft absorptive urethra. But in the cases where ordinary cystoscopy is done we can safely use it. However, we must select our cases.

Dr. John A. Hawkins (Pittsburgh): Twenty years ago I had an exciting experience after using cocaine to do a cystoscopy, and I blamed it on the cocaine. I have not used it in the office since, though we use it in the hospital all the time—about 1 cc. of a 4 per cent solution, by Ultzmen's syringe preferably, or by forcing it back with a large syringe and air.

I wish to present a case of a woman who was prepared by the nurse and while I was putting on my gloves the nurse called my attention to the fact that this woman was in bad shape. I looked at her, and if I had given her cocaine I would have said it was cocaine poisoning that was causing the shock. She was in such a condition that I sent her back to her room, and I never did cystoscope her, as she left the hospital when told that the X-ray showed a stone in her kidney. I believe a large percentage of these deaths are due to shock and not to the anesthetic.

Dr. Alfred I. Folsom (Dallas): I am sorry I did not hear Dr. Randall's paper because I am intensely interested in this subject. In a discussion of local anesthetics in the urethra there are usually two camps—those who use cocaine, and those who use some other form of local anesthetic.

In regard to substitutes for cocaine, I feel the others do not give me the amount of anesthesia that I should have for instrumentation of the urethra. My judgment is entirely in harmony with that expressed by the Chairman when he says that people who have to go through a cystoscopy are entitled to some kind of anesthesia if it can be given without danger. For the last eight or nine years I have used as a routine in my office and hospital a 2 per cent solution of cocaine. I use from 5 to 9 cc., and instil it into the urethra and bladder slowly, and depend on that for the anesthetic effect. It seems to me in our experience of eight or nine years we should have had more serious consequences if it was directly traceable to cocaine. I have never had any experience that in any way worried me as to the use of cocaine. I believe if you use it in that strength and use it by forcing it through the urethra slowly, you will not get many cases of cocaine poisoning. I am glad to hear expressed the opinion that probably some of these patients really did not die of cocaine poisoning. My personal experience is that cocaine in 2 per cent solution is not an unsafe anesthetic in the urethra. I always make up my solution myself in the office, and I think a good many times if you are not careful in having the solution made you will get a stronger solution than you think you are using.

Dr. H. McC. Young (St. Louis): I use cocaine. I think proof is lacking that it is more toxic than alypin. The only thing I know to be less toxic is novocaine, and it is less effective. I believe the danger with cocaine is more in the way it is used than in the strength of the solution. I think force should never be used in putting cocaine into the urethra. I would never attempt to force cocaine back of the cut-off muscle. I have an instillator equipped with a glass syringe, and the weight of the piston is all that is necessary to drive the cocaine into the deep urethra. No force is exerted. I have seen cases with alarming symptoms after cocaine, and in every case I think there was fault in the technique. Of course if you are dealing with stricture and attempt to force a cocaine solution through it you are apt to force the cocaine into the lymphatic spaces. I do not think that should be done. If there is bleeding I do not think cocaine should be used.

I think it would be a great mistake for this organization to go on record as disapproving the use of cocaine in the urethra, because some of us who use it and think we cannot get satisfactory anesthesia with anything else will probably continue to use it, and it would put us in a bad light. I do not think it would be quite fair. I am open to conviction, but I do not believe I can get anesthesia with anything else, and I do not feel it is dangerous if it is used with proper caution.

Dr. H. W. E. Walther (New Orleans): I am a recent convert to cocaine. Formerly I was very conservative and used novocaine, but I did not get anesthesia. I thought for a while that local anesthesia in cystoscopy was not all that was claimed of it. After my visit last year to St. Louis, where I saw urologists using cocaine liberally, I decided that if they could use 2 to 5 per cent solutions and get by without any trouble, I could safely use 1 per cent solution. For a year I have used 1 ounce of 1 per cent cocaine with 5 or 6 minims of adrenalin, and I have had no trouble whatever, and have secured perfectly satisfactory anesthesia.

Dr. A. J. Crowell (Charlotte): We have practically abandoned the use of cocaine in our office as the result of having had two deaths following its application to mucous surfaces. A 2 per cent solution was injected into the urethra and retained for two or three minutes in each of these cases. The first was the next day after an unsuccessful attempt to catheterize the patient under chloroform anesthesia by his family physician. Considerable trauma had been produced in this effort and the patient was under the influence of chloroform for three or four hours, I am told. Without any previous symptoms, the patient was seized with a hard convulsion and had one after another until his death a short time thereafter.

The second case was one in which the same amount and same strength of cocaine was used four days previously to anesthetize the urethra for the purpose of crushing and evacuating bladder stone. This patient was also seized by hard convulsions in not more than three minutes after the solution had been injected into the urethra. These continued until his death shortly afterward. Many people are very susceptible to the drug, even though there be no destruction of the epithelial cells of the mucous membrane. I feel that where the mucous membrane is broken it is far more dangerous.

Dr. Hugh H. Young (Baltimore): Personally, I never had a death from local anesthetic, but I came very close to having one from 2 per cent cocaine into the urethra, under conditions exactly like Dr. Crowell's, although his case had been instrumentized. I think the explanation is that there was a lesion in the urethra in his case, and certainly there was in mine. Mine was a case of stricture of the urethra where an attempt was made at the hospital to get in and they could not, and brought him to me.

I put in a 2 per cent solution, and he came within an ace of dying—was barely saved. I feel sure there the cocaine got into the traumatism produced before the cocaine was introduced.

After that experience I realized that you had to use cocaine with great care where stricture is present and there must be instrumentation. I think that would probably explain a good many of the deaths. Since then I have been using 4 per cent procaine in the urethra. I do not get as good anesthesia, but we do all of our cystoscopies with 4 per cent procaine. I think a great majority of cases can be done that way. I admit it is a little painful. I would not like the idea to go abroad that we can go back to cocaine and never expect deaths. There are those who have an idiosyncrasy to it and you can use a safer drug.

Dr. D. L. Simon (Pittsburgh): We have been in the habit of using 5 per cent novocaine as a routine for cystoscopy and other instrumentation, and have never noticed any trouble. I do not think the anesthesia is as good as with cocaine. During the war, not being able to get novocaine, we used in 300 to 400 cases 1 per cent cocaine, and in 2 cases we nearly had death. These men were in bad shape for a number of hours. I feel that inasmuch as these cases had both been recently instrumentized, that accounted for it. In any case where recent instrumentation has been done I think we should avoid the use of cocaine, regardless of what our rule has been in the past. In those cases I think it would be better to be more conservative and get a little less anesthesia by using novocaine.

Dr. E. O. Smith (Cincinnati): When I was a student in Medical College we were told of the disastrous effect of cocaine in certain individuals who were very susceptible to this drug, and how a simple throat spray containing a very small quantity of cocaine may cause alarming symptoms of cocaine poisoning. This statement impressed me to the extent that I always considered cocaine a drug not without danger.

Whenever I used cocaine in the urethra, the solution was very weak and the quantity not large. I have had no disastrous results, but a few have shown evidence of mild cocaine poisoning. It has been my experience that most all patients can be satisfactorily cystoscoped without much discomfort when no local anesthetic is used. It is not painless, but the secret of cystoscoping patients with as little pain as possible without a local anesthetic is in taking time in introducing the cystoscope. When the cystoscope reaches the cut-off muscle, do not force it through; give the man a chance to relax, and by taking a minute or two the cystoscope will slip through without much difficulty. I am absolutely opposed to making a routine use of cocaine in the urethra for the ordinary cystoscopic examination. It certainly is not necessary to put it into the anterior urethra. Ordinarily the anterior urethra will take the cystoscope without any trouble. In the posterior urethra it is not necessary to use anything stronger than a 1 per cent solution of novocain, and give it time to be absorbed. I am almost convinced that you can do as much with the posterior urethra by introducing adrenalin. It is not particularly anesthetic in effect, but it does contract the tissues and in this way is helpful. I do not want to go on record as saying that no case should have anesthesia for the use of the cystoscope. There are cases where it is absolutely impossible to make a cystoscopic examination without an anesthetic. These cases are usually tuberculous, and to them I prefer to have given a little gas.

When it comes to instrumentation of urethral strictures, a great deal more will be accomplished by passing a filiform, or anything that will go through with ease, and leave it there an hour or so, than by a local anesthetic. Later, something larger can easily be introduced. I believe if we will practise patience, take time, and not try to hurry these cases, we can accomplish what is desired in practically all cases without anesthesia.

Dr. Joseph L. Boehm (New York City): It may be considered outside the range of urology to take the blood pressure of the patient and also make cardiac examinations. I have used cocaine for a number of years and have had some sad experiences with it, until I investigated the cause. Two cases were followed to the postmortem table. One met accidental death shortly after his last instrumentation and cocaine injection, and it was found that he had a warty vegetation on his mitral valve. The other had an aortic valve lesion. After my experiences and an investigation of the subject we have laid down a rule that with a high diastolic pressure, or with a persistent low pulse pressure, beware of cocaine, especially when it is combined with adrenalin, in the deep urethra. It is advisable in many chronic cases if you continue the use of cocaine to look into the cardiac apparatus.

Dr. HUGH H. YOUNG (Baltimore): I was interested in talking to Dr. Crile to find that he never thinks of adding adrenalin to any local anesthetic—that he considers it extremely dangerous. I consider him the greatest authority, both on local anesthesia and the use of anesthetics in large amounts, and also on adrenalin.

Dr. ALEXANDER RANDALL (closing): I cited in my paper but 8 men who were favorable to the use of cocaine. One would think they were all here, as 6 of those taking part in the discussion have been in favor of the use of cocaine. However, I feel that the other side hardly needs defense after our statistics, and moreover these statistics only scratch the surface of the existent facts, as we have received but 40 per cent of replies to the 837 letters.

I had to report but 6 deaths. This possibly is not striking, but in this short discussion, Drs. Livermore and Crowell have frankly added 3 further deaths, and I know from other experiences that the total is well above this seemingly small number.

Dr. Walther has mentioned his technique as being the use of 1 ounce of a 1 per cent solution. Dr. Lespinasse has already told us that the maximum dosage should not exceed 0.75 grain. Dr. Walther's 1 ounce contains 4.8 grains of cocaine, and I should think he is treading on very thin ice. Dr. Marks has suggested that these deaths might not be essentially due to cocaine. I can but say that though I did not trouble you with the details of the individual cases, there is no doubt in my mind that each case died of acute cocaine poisoning.

I have been asked what I used. My report is not a personal one but a compilation of the reports from a circular letter sent out by the American Medical Association. However, I am glad to add that in possibly 4 out of 5 cases I do not feel it necessary to use any anesthesia, and I do not believe that I cause any more discomfort than that occasioned by the passage of a catheter or a sound. We try earnestly to select our cases, to use the anesthesia best suited, whether it be a local, "vocal" or sacral anesthesia.

I was delighted to hear Dr. Smith so frankly state that he does not feel the need of any local anesthesia, and I know there are others in the audience who likewise agree that while cocaine has no equal, they do not feel called upon to run the risk that its use entails, and have not gained any satisfaction with the various substitutes.

The two lessons I wish to leave with you are: First, the propriety of selecting your cases and suiting the anesthesia to the patient; and second, that in case of a stricture of the urethra, cases where traumatism has been or may be done, and cases where unhealthy tissue is known to exist, cocaine should never be used.

A NEW TYPE OBSERVATION AND OPERATING CYSTO-URETHROSCOPE[1]

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Notwithstanding the great and fairly continuous progress that has been made in recent years both abroad and here, in the design and construction of cystoscopes and endoscopes there has long been a need for an instrument such as is herewith described. Heretofore in cystoscopy and endoscopy two general types of periscopes have been employed, one with the axis deflected at right angle, the other looking directly ahead. The former is employed in exploration and in operative procedures of the bladder and urethra, but necessitates a mechanical contrivance for deflecting the instruments. The lens system for direct vision while adequate for visualization has been comparatively ineffective for operative manipulation, at least in so far as the telescopic type is concerned. This because of the fore-shortened picture resulting when the object to be visualized is parallel and in close proximity to the optical axis.

For years the writer has been endeavoring to enlist the cooperation of Mr. Reinhold Wappler, whose genius in this field is now happily, a matter of universal recognition, and through whose collaboration we have finally succeeded in designing an instrument that will permit of direct ureteral catheterization without deflection and enables one to carry on intravesical and intra-urethral operative manipulations with rigid appliances, meanwhile visualizing the distal end of these instruments with as much precision as heretofore has been done with the deflecting type of prismatic cystoscopes.

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[1] Read at the meeting of the American Urological Association, Rochester, Minnesota, May, 1923.

This new instrument carries a forward looking lens system at such an angle that the lamp is placed at the extreme end of the telescope and within the same diameter so that when introduced into an endoscopic tube, it brilliantly and uniformly illuminates the visual field and at the same time affords a large operating chamber. This has been accomplished by constructing an objective system on the end of a periscope which deflects the angle of the optical axis about 25 degrees. It was obvious that one or the other thing had to be done, either the operating appliance had to be deflected or the optical axis deviated to a convenient angle and the operative appliance manipulated without deflection.

The details of the lens system are as follows. The objective system consists of a double acting prism having one surface at an angle of 20 degrees from the axis and another surface at 5 degrees. The surface of 5 degrees is silvered; the other surface remains plain inasmuch as it acts by total reflection.

The instrument consists of a sheath which is straight with the vesical end cut obliquely for purpose of better visualization. The sheaths are of varying caliber and type, one a single oval tube, the others consisting of two tubes, one large or main tube to whose upper wall a tunnelled sheath is soldered; the upper and smaller tube carries the telescopic apparatus. The outer part of the tube is equipped with the usual irrigating cocks. The end is closed by a lock attachment with two terminal openings, the shorter admitting the passage of operative appliances, catheters, etc., the longer tube is the carrier for telescope and lamp. The eye piece as will be observed is some distance away from the entrance to the cystoscope proper. This gives a working space of about 5 cm. Before introducing the obturated cystoscope it is necessary to adjust the telescope with its attached light carrier. This is done by placing the telescope in situ, the little ivory point attached to the eye piece indicates the proper position for the same. Nevertheless, it is desirable to visualize the distal outlet of the tube to obviate the necessity of readjustment after the instrument has been introduced. Once adjusted so that a perfect circular field is seen without visualizing the interior of the tube, the upper key is turned quite firmly to fix the telescope in this position. The optical unit is then removed, the obturator introduced. The instrument is then passed into the bladder, obturator withdrawn and the telescope once more placed in position.

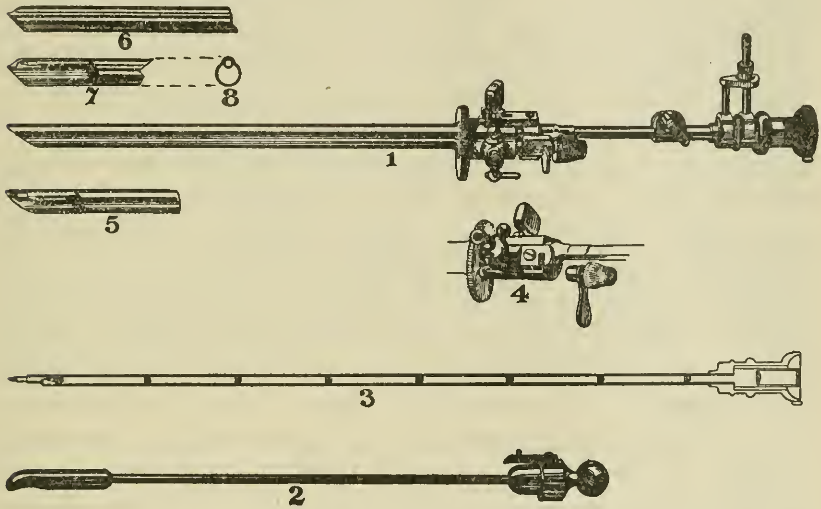

Fig. 1. The Instrument as Assembled
Fig. 2. The Obturator
Fig. 3. The Telescope Showing Terminal Lamp, Collecting Lens, Prism Reversal Lenses and Eye Piece
Fig. 4. The Detachable Closure with Rubber Cap
Fig. 5. Position of Telescope in Simple Oval Tube
Fig. 6. Tube with Separate Telescope Carrier
Figs. 7 and 8. Construction of Large Size Sheath which Enables One to Operate through Separate Tunnel

The technique of manipulation of this instrument is simple though totally different from that of the indirect type. The picture is likewise quite unlike that of the other type. It merely consists in pointing the cystoscopic sheath just as one would point a gun at an object, and with the internal sphincter as a fulcrum, raising or lowering the ocular end of the instrument in order to obtain a proper focus. When this is accomplished and the ureter visualized one may approximate the instrument directly over the mouth of the latter if need be, and introduce catheter or foreign body forceps. This cystoscope will permit of the introduction of straight endovesical operating instruments of the rigid type such as forceps, scissors and bougies. The smaller instrument will carry a no. 13 F. catheter and the larger type of no. 18 F. In a tolerant bladder only a minute quantity of irrigating fluid is required, so little in fact that closure of the outer irrigating end in such cases is quite unnecessary. In the writer's hands it has already permitted of catheterization of ureters that had proved impossible with the indirect type. In the event of a burned out lamp one may withdraw the telescope with the ureter catheter in situ and reintroduce the same over the catheter regardless of the size of the latter. The telescope is adjustable to sheaths of different calibration and varying lengths. It may be used for the longer cystoscope in which the writer at present employs a 17.5 cm. working length as well as in the smaller anterior urethroscope of a 10 cm. working length. The instrument is intended as a direct observation instrument for the bladder and an operative one for the trigone, ureters and urethra. It reveals the internal sphincter and the posterior urethra with verumontanum in a remarkable and quite different manner than heretofore. It permits in the male and female the employment of the waxed catheter technique which has proved so successful in the hands of Hunner, and who ventured the opinion that the reason ureteral stricture was so infrequently found in the male was because it was not sought for so diligently or with such facility as in the female. The writer believes this instrument removes the last excuse for failure to find such conditions if they exist. In the female this instrument will permit of the operative intra-ureteral and intra-vesical manipulations afforded by the Kelly type of female cystoscope, at the same time, it obviates the disagreeable and uncomfortable position necessitated by the latter. It will likewise permit of uniform dilatation of the ureter up to a no. 18 F. and removing as it does, the necessity for deflection of instruments, will simplify intra-ureteral manipulations. Though this procedure has not as yet been attempted, it appears feasible to remove with improved type of cautery knives, under vision, wedge-shaped sections in vesical neck fibrosis, applications to the verumontanum of diathermic electrodes designed for the purpose, and catheterization of ejaculatory ducts are also possible intra-urethral manipulations.

It is the confident prediction of the writer that this new instrument will revolutionize our present cystoscopic operative manipulations and within a very brief period, constitute a part and a very important part of the armamentarium of workers in the field of urology in the male and female. The underlying principles here incorporated are already in the process of application to the construction of the newer type bronchoscopes, oesophaguscopes and sigmoidscopes.

In conclusion the writer wishes it clearly understood that this instrument does not, nor is it intended to, supplant the very efficient indirect cysto-endoscope now giving such universal satisfaction.

A NEW CYSTO-URETHROSCOPE FOR EXAMINING AND OPERATING ON ANY PART OF THE URINARY TRACT BY DIRECT-TELESCOPE OR INDIRECT-PERISCOPE METHODS

G. S. GORDON

Vancouver, British Columbia

Received for publication September 1, 1922

Cystoscopes and urethroscopes of numerous makes and designs on the market today are so nearly perfect in construction, that one must be very sure of one's ground before offering to add to their number. The one thing lacking so far is, that no single instrument takes the place of all the others required for complete urethral, cystoscopic or ureteral work.

This instrument needs to be inserted only once for no matter what examination or operating is to be done; it can be used with a telescope or a periscope without withdrawal and reinsertion; it reduces the total number of working parts and simplifies them; it allows stronger instruments to be used; and with all, which has been most difficult of attainment, the instrument, it is hoped, is as good as the best for any use to which it is put. This balancing of the different requirements of the combined instrument so that it does not degenerate into a make-shift for some purposes while excellent for others is what has taken up time and experiments for the last ten or twelve years.

During this period others working independently have brought out improvements similar to those incorporated herein. There is hardly any part of the instrument which, in some form or other, is not on the market somewhere; e.g., Geringer's endoscope perhaps the most perfect of its kind today, came out while I was using the same principle in a model which is still doing daily duty; the ureteral meatotome, I am informed, is much the same as in use in Italy; and, finally, the straight heavy instruments to be used with the telescope are on the same lines as the Papin operating cystoscope which was manufactured, perhaps as long ago as when I first began to use this principle.

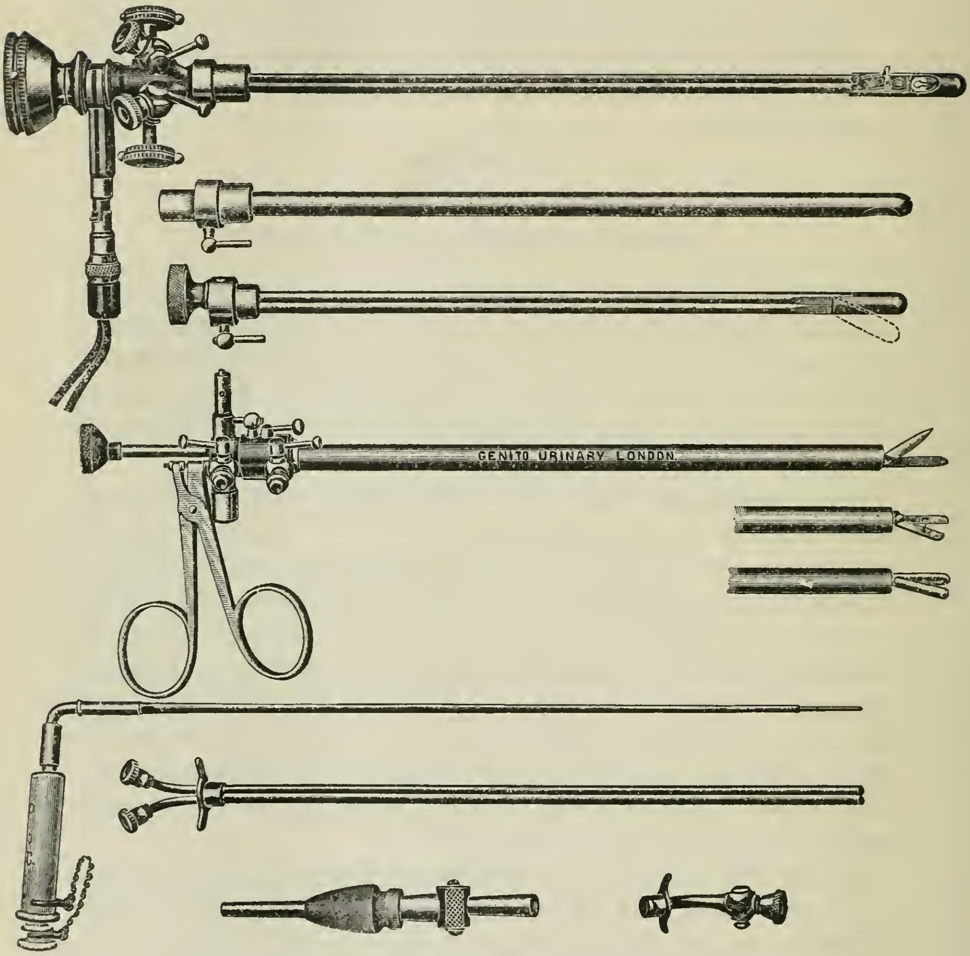

Fig. 1. Details of New Cysto-urethroscope

The introduction of any instrument into the bladder is accompanied by more or less discomfort which sometimes amounts to pain requiring a local or general anesthetic to control. Often the least instrumentation possible is called for. It is even questionable at times whether it is advisable to cystoscope at all, so much harm may be done by cystoscopy. Therefore, there is a call today for an instrument with which one can accomplish the maximum at one sitting.

A pleasant surprise awaits those who have not used the open-ended, water-dilating posterior endoscope. Through this not a patch of the urethra only, but the whole circumference is seen in a field large enough to embrace both abnormal and normal areas, so that any lesion present contrasts with its environments.

Those who have used the wiggly tools supplied with all operating periscopes will appreciate this system which allows larger, stronger and simpler ones to come directly into the field of vision by a single thrusting movement.

This cysto-urethroscope is housed in a tube of 24 caliber (French) to introduce which through the urethra into the bladder an obturator with curvable beak is used. Straighten the beak, withdraw the obturator and leave this sheath in place. The urine escapes. Insert the irrigating nozzle into the tube up to the rubber stopper and fill the bladder. Withdraw the irrigating nozzle to drain the bladder, if it is foul, and repeat filling and emptying the bladder until the outflow is clear. Lastly keep the bladder filled with clear solution, by holding the left thumb over the outlet of the sheath. The right hand lays aside the irrigating nozzle, takes up the periscope and carries it quickly and smoothly home in the sheath (the left thumb having been removed at the last moment). Should too much fluid have escaped in this manipulation leaving the bladder insufficiently distended, or should one prefer to have a stream of fluid flowing constantly and directly over the field of vision while cystoscoping, insert the tip only of the irrigating nozzle into the small rubber tube attached to the open side tap. Should the bladder get too full during manipulations turn off the inflow and loosen the periscope in its socket sufficiently to allow the superabundant fluid to escape. The periscope is used for examining, for catheterizing the ureters, or for fulguration.

The light will be found good, the field large and clear and the catheter carrying tubes of ample size to carry no. 6 catheters.

The periscope, having served its purpose, is removed and, if required, the telescope takes its place in the sheath. Through the tap, fluid is allowed to flow and lift the collapsed bladder off the open end of the sheath. Then the trigone can be seen en profile or en face at will. It will be found occasionally that ureters which can not be catheterized by the indirect periscope method can be catheterized by the direct telescope method. The direct telescope method is also used if a very large single catheter or sound is to be passed.

The telescope has soldered to its sides the lighting apparatus and a return water tube (the use of which is to be explained later). Under the telescope and capable of backward and forward movement, may be inserted catheter carriers, scissors, forceps, ureteral meatotome, utricle syringe, or a hook for removing filiforms, hairpins, etc.

When one of these accessories is in place under the telescope it practically forms part of the instrument so that when one brings an object into the center of the field of vision only a forward thrust of the accessory is necessary to bring it in contact with its objective. Shearing, slitting, grasping, insertion or injection then can, be easily accomplished.

When used in the posterior urethra the telescope, *under direct vision*, is gradually withdrawn from the bladder, care being taken that distending fluid, under a few feet of pressure, is continually flowing through the sheath to dilate internal sphincter and posterior urethra. The amount of distention can be easily regulated by the height of the irrigator and by the tap on the side of the sheath. If the bladder, into which the distending fluid has flowed, gets uncomfortably full, it is to be emptied by carrying the scope back into it, closing the tap and loosening the telescope in its sheath. Resocketing the telescope, and reopening the tap permits renewed examination or work on the posterior urethra. The scope can usually be carried back and forth in the posterior urethra, if distention is kept up, with only slight discomfort to the patient. Bullae, papillomata, sinuses, ulcers, congested areas, distortion from scars or adenomatous bulgings, inflammation of the utricle, stricture, etc., can be all clearly differentiated, when present, through this form of endoscope and remedial instrumentation done where indicated. Finally, on withdrawing it through the external sphincter, the scope can be used as an anterior endoscope, by making use of the extra tap as an evacuator of the distending fluid. Pressure in the anterior urethra can be regulated by manipulation of the inflow and outflow taps. Thus at one sitting, beginning at the bladder and working out, one can examine or operate on any part of the urinary tract.

I think the irrigating nozzle is worth calling attention to. It can be used with any irrigating cystoscope to carry fluid directly through the main tube or through the taps at will. It will be found very useful where large quantities of fluid are required to flush out and clean a very dirty bladder quickly or to flush the field of vision under direct observation when cystoscopy is under way.

These instruments are manufactured by the G. U. Manufacturing Company Ltd. of 66 Margaret Street, Oxford Circus, London, W. 1, and can be bought separately as cystoscope, urethroscope (with or without further armamentarium) or complete examining and operating cysto-urethroscope.

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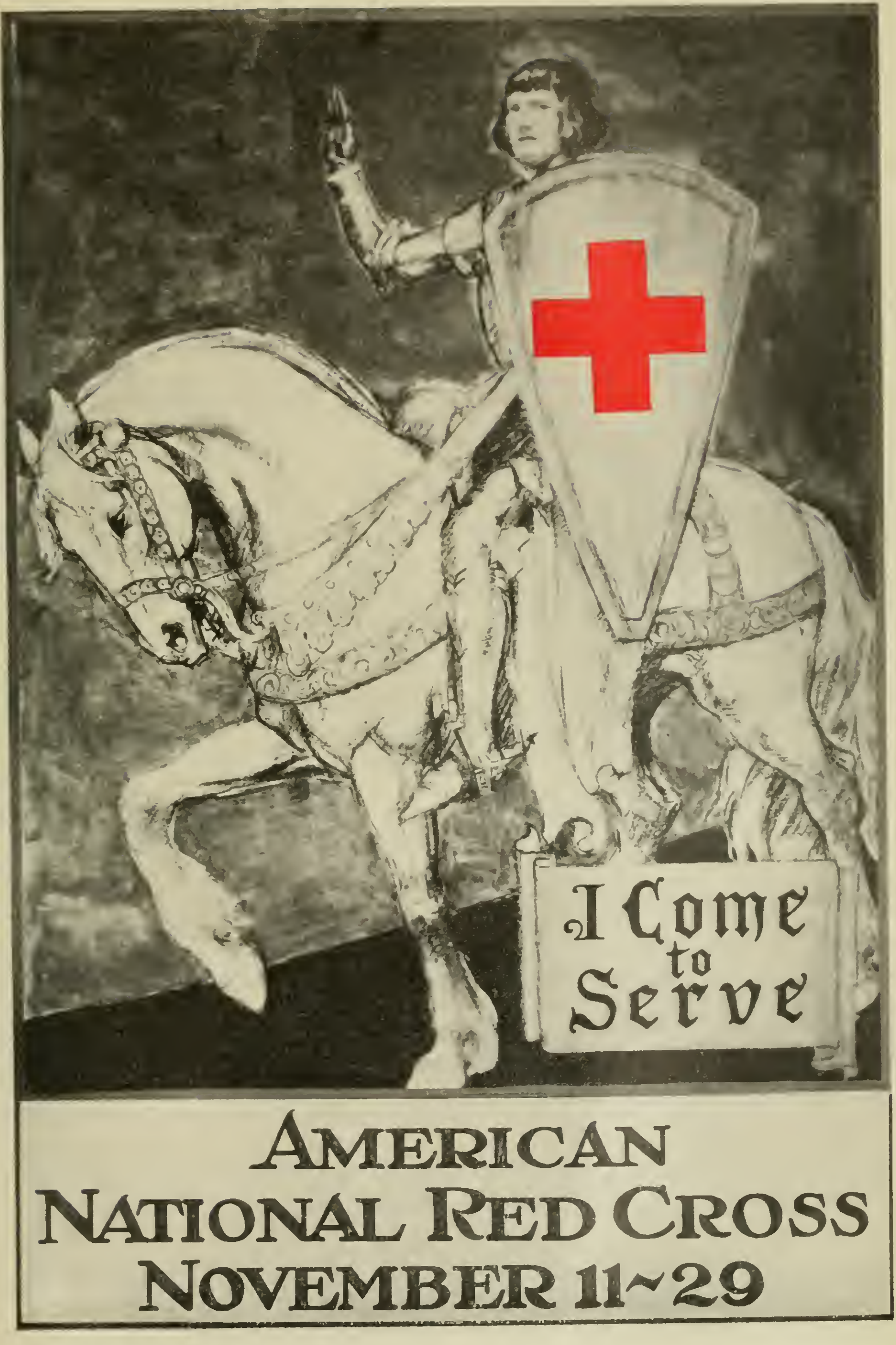
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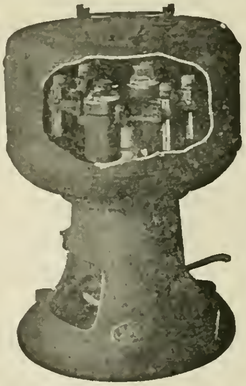

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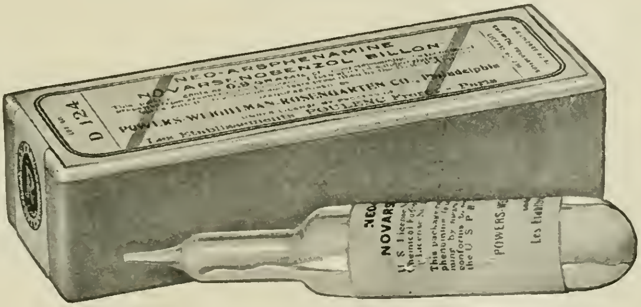
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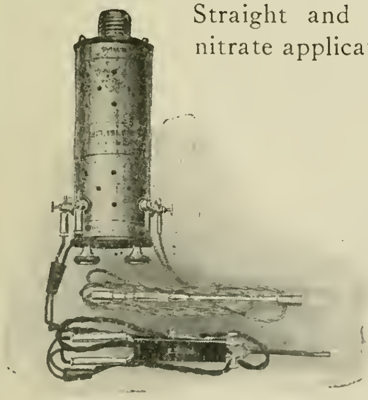

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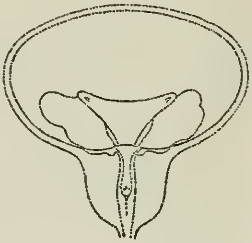

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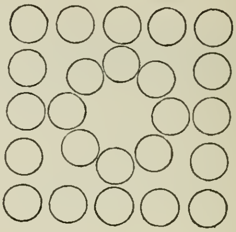

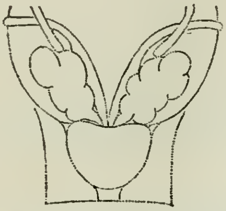

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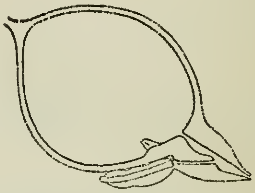

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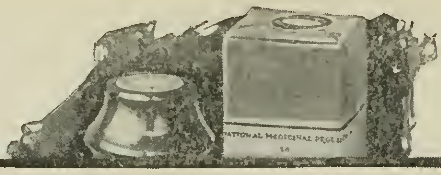

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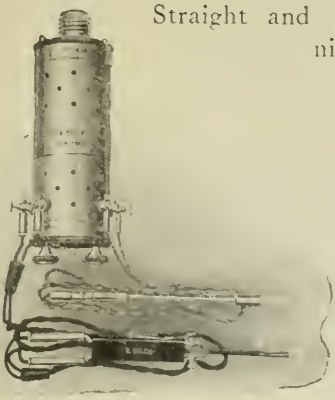

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